CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT — DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. VII

RÉDIGÉ PAR
H. BLEGVAD †
AVEC L'AIDE DE
AA. J. C. JENSEN

1950

EN COMMISSION CHEZ
ANDR. FRED. HØST & FILS
COPENHAGUE

Prix: kr. 25.00

Décembre 1951

NIELSEN & LYDICHE (M. SIMMELKIÆR)
COPENHAGUE

TABLE OF CONTENTS

Page

Reports

North-Eastern Area

The Fish. Arcto-Norwegian Stock of Cod — G. Rollefsen 7

North-Western Area

Introduction, by Å. V. Tåning 8

Environment. Hydrography (N. North Atlantic) — J. Smed 9

(SW. Norwegian Sea) — F. Hermann... 13

(Faroes to E. Greenland) — F. Hermann 18

(N. Iceland) — Unnsteinn Stefánsson. 19

(W. Greenland) — F. Hermann..... 21

Plankton (Faroe-Iceland Waters) — J. H. Fraser 25

(Faroe-Shetland) — Å. V. Tåning 25

The Fish. Faroe. Eggs and Larvae — A. Saville 26

0-Group Cod, Haddock, Coalfish — E. Bertelsen . 27

Haddock — R. Jones 28

Lemon Sole — B. B. Rae 32

Halibut — A. D. McIntyre..... 33

Iceland. Cod — Jón Jónsson 33

Haddock — Á. Friðriksson & G. Timmermann . 34

Plaice — B. B. Rae & J. M. Lamont 36

Lemon Sole — B. B. Rae..... 36

Halibut — A. D. McIntyre 37

Exotic Fishes — B. B. Rae..... 38

Greenland. Eggs and Larvae — Å. V. Tåning..... 38

Comité Atlantique

Introduction, par J. le Gall..... 41

Les Conditions de Milieu.

Hydrologie (Côtes Marocaines) — J. Furnestin 42

Fishery Hydrography — V. F. C. Veley..... 44

Plancton (Côte du Maroc) — M.-L. Faure..... 47

Les Poissons.

Gadidés: Merlu. Le Stock en 1950 — R. Letaconnoux..... 49

Clupéidés: Sardine: Golfe de Gascogne, Santander, Vigo, Côte Est d'Espagne, Baléares, Côte du Maroc — J. le Gall; J. Fleury; R. Fernandez & F. Navarro; M. Oliver & F. Navarro; B. Andreu, J. Rodriguez-Roda & M. G. Larraneta; J. Furnestin & M.-L. Faure 50

Anchois (Côte du Maroc) — J. Furnestin & M.-L. Faure..... 59

Sardinelle (Baléares) — M. Oliver & F. Navarro.... 59

Page

Scombridés: Maquereau — J. le Gall 61
Thonidés: Germon (Examen des Branchiospines) — R. Letaconnoux 63
(Examen des Ecailles) — H. Heldt 63
(Corrélation Taille/Fréquence) — J. le Gall.... 64
La Bonite (Ichthyométrie) — J. le Gall 66

Northern North Sea

Review, by C. E. Lucas..... 67
Environment. Hydrography (Scottish Investigations) — J. B. Tait 69
Plankton (N. of the British Isles) — K. M. Rae 72
(Scottish Investigations) — J. H. Fraser.... 76
The Fish. Haddock (Scottish Investigations) — R. Jones & W. Main 77
Whiting (British Statistics) — R. W. Ellis 81
Plaice (Scottish E. Coast) — B. B. Rae & J. M. Lamont.. 81
Lemon Sole (Scottish Investigations) — B. B. Rae 82
Rare Fishes — B. B. Rae & E. Wilson 83

Southern North Sea

Introduction, by R. S. Wimpenny 84
Environment. Hydrography (Lightvessel "Vyl") — H. Thomsen 85
(S. North Sea) — J. Smed..... 85
The Fish. Demersal Species (Dutch Fishery) — L. K. Boerema 88
Plaice (0-Gr. in the Danish Waddensea) — Å. V. Tåning 91
(Danish Investigations) — Aa. J. C. Jensen..... 92
(Sex-Ratio and Effect of Fishing) — R. S. Wimpenny 94
Dab (Horns Reef Area) — Aa. J. C. Jensen 96
Sprat (Echo-Sounder Surveys) — I. D. Richardson..... 97

Transition Area

Introduction, by E. M. Poulsen 99
Environment. Hydrography (Kattegat and Belts) — H. Thomsen 100
(Coast of Skagerak) — A. Dannevig.... 101
Benthic Food — J. Knudsen 101
The Fish. Eggs and Larvae — J. B. Kirkegaard 102
Gadidae (Danish Waters) — E. M. Poulsen, J. Knudsen 102
(Norwegian Waters) — A. Dannevig..... 103
Plaice (Coastal Investigations) — Aa. J. C. Jensen, A. R. Molander..... 103
(Stock in the open Sea) — Aa. J. C. Jensen 105
(Limfjord Stock) — E. M. Poulsen 106
(Market Measurements) — Aa. J. C. Jensen 106
(Transplantations) — E. M. Poulsen 107
Flounder and Turbot — E. M. Poulsen..... 107
Dab (Limfjord Stock) — E. M. Poulsen 107
(Other Danish Waters) — J. B. Kirkegaard & J. Knudsen 107
Eel — Aa. J. C. Jensen 108
Fish for Processing — I. Bohus Jensen..... 109
Rearing Experiments — A. Dannevig..... 109
Shellfish (Lobster, Oyster) — A. Dannevig 110
(Deep Sea Prawn. Norwegian Lobster) — E. M. Poulsen 110

Baltic Area

Page
Introduction, by Chr. Hessle 111
Environment. Hydrography (Danish Observations) — Aa. J. C. Jensen 112
(Swedish Observations) — H. Alander . 112
Plankton — Aa. J. C. Jensen 114
The Fish. Larvae — Aa. J. C. Jensen 114
Cod (Danish Investigations) — Aa. J. C. Jensen 114
(Swedish Investigations) — H. Alander..... 115
Flat Fish (Danish Investigations) — Aa. J. C. Jensen..... 115
(Swedish Investigations) — H. Alander..... 115
Sprat — H. Alander..... 116

Herring

Introduction, by Á. Friðriksson..... 117
Reports. Iceland — Norwegian Sea
Young Stages (Iceland) — Á. V. Tåning..... 118
(Faroe) — A. Saville..... 119
Commercial Fish (Faroe) — Á. V. Tåning..... 119
(Iceland, south coast) — H. Einarsson 120
(» , north coast) — A. Friðriksson 122
(Norwegian Investigations) — Finn Devold..... 125
Tagging Experiments — O. Aasen..... 127
Special Investigations — O. Aasen..... 127
North Sea and Channel
Young Stages (At Scotland) — G. McPherson..... 127
(Off Esbjerg) — Aa. J. C. Jensen..... 128
Commercial Fish (Scottish Fishery) — H. Wood..... 128
(Dutch Fishery) — J. de Veen, L. K. Boerema..... 131
(Belgian Fishery, full Herring) — Ch. Gilis 138
(» » , spent Herring) — Ch. Gilis 144
(La Pêche Française) — J. Ancellin.. 141
Skagerak and Northern Kattegat
Danish Fisheries — Aa. J. C. Jensen 147
Central and Southern Kattegat, Belt Sea and Baltic
Young Stages — Aa. J. C. Jensen 149
Commercial Fish — Aa. J. C. Jensen 149
Tagging Experiments — Aa. J. C. Jensen..... 151

Shellfish

Shrimp (Statistical Investigations) — B. Havinga 153
Oyster (Larvae and Spatfall in the Oosterschelde) — P. Korringa... 157

Résumé of Subjects.

Environment. Hydrography: NW-A., N. North Atlantic, p. 9; SW. Norwegian Sea, p. 13; Faroes, p. 18; Iceland, p. 19; Greenland, p. 21. Cté Atl., Morocco, p. 42. NNS, p. 69. SNS, p. 85. Tr. A., p. 100. Baltic, p. 112.
Plankton: NW-A., Faroe, p. 25. Cté Atl., Morocco, p. 47. NNS, p. 72. Baltic, p. 114.
Benthic Food: Tr. A., p. 101.

The Fish. Eggs and Larvae: NW-A., Faroe, p. 26; Greenland, p. 38. Tr. A., p. 102. Baltic, p. 114.
Demersal Seafish: SNS, p. 88.
Cod: NE-A., p. 7. NW-A., Faroe, p. 27; Iceland, p. 33. Tr. A., p. 102. Baltic, p. 114.
Haddock: NW-A., Faroe, p. 28; Iceland, p. 34. NNS, p. 77.
Hake: Cté Atl., p. 49.
Whiting: NNS, p. 81. Tr. A., p. 103.
Coalfish: NW-A., Faroe, p. 27.
Flat Fish: Tr. A., p. 107. Baltic, p. 115.
Plaice: NW-A., Iceland, p. 36. NNS, p. 81. SNS, p. 91. Tr. A., p. 103.
Dab: SNS, p. 96. Tr. A., p. 107.
Lemon Sole: NW-A., Faroe, p. 32; Iceland, p. 36. NNS, p. 82.
Halibut: NW-A., Faroe, p. 33; Iceland, p. 37.
Herring: pp. 117—152.
Sprat: SNS, p. 97. Baltic, p. 116.
Sardine: Cté Atl., pp. 50—59.
Sardinelle, Anchois: Cté Atl., p. 59.
Mackerel: Cté Atl., p. 61.
Germon: Cté Atl., p. 63.
La Bonite: Cté Atl., p. 66.
Eel: Tr. A., p. 108.
Rare and Exotic Fish: NW-A., p. 38. NNS, p. 83.
Fish for Processing: Tr. A., p. 109.
Rearing Experiments: Tr. A., p. 109.
Shellfish: Tr. A., p. 110. Shellfish Ctee., pp. 153—158.

North-Eastern Area.

THE FISH

The Age Distribution of the Arcto-Norwegian Stock of Cod.

THE cod ("skrei") in Lofoten consists of mature individuals of the Arcto-Norwegian stock of cod. The age determinations by means of otoliths which have been undertaken on skrei since 1932 therefore have bearing only on the mature part of the stock.

In the last years the number of age determinations has ranged from 3000 to 10,000 each year, and it has been found to be of great interest to treat the males and females separately.

The following table gives the age distribution in % for the years 1945—1950. The underlined figures show the development of the 1937 year-class.

GUNNAR ROLLEFSEN.

Age Distribution in % of "Skrei" 1945–50.

	1945		1946		1947		1948		1949		1950	
Age	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
6	—	—	—	—	—	0.09	0.06	0.2	0.04	0.43	0.07	0.3
7	0.2	0.8	0.05	0.3	0.12	0.9	0.6	1.8	1.84	5.08	2.1	4.7
8	16.7	23.4	2.2	3.4	1.9	3.1	1.8	2.9	5.43	11.35	16.7	28.7
9	14.2	18.3	39.3	50.0	8.2	12.0	4.3	6.6	6.94	7.92	22.6	25.3
10	16.0	16.1	17.2	16.8	46.8	51.6	14.1	15.5	8.07	8.35	12.0	11.6
11	20.7	20.2	11.9	9.2	14.2	13.3	49.4	47.5	12.3	12.0	7.8	5.4
12	17.1	12.0	13.8	10.0	8.0	6.3	10.7	8.9	36.2	32.1	8.5	4.5
13	7.0	5.65	9.1	6.4	9.5	6.1	5.3	4.5	8.94	8.36	15.8	10.2
14	2.6	1.46	3.7	2.6	6.4	3.9	5.9	5.5	5.63	4.53	3.6	2.0
15	2.9	1.2	0.9	0.5	2.1	1.6	4.6	3.6	6.18	4.65	2.7	1.7
16	1.8	0.46	1.0	0.5	1.2	0.4	1.3	1.5	4.38	3.18	3.0	2.3
17	0.6	0.27	0.5	0.2	1.1	0.3	0.7	0.6	1.82	1.10	2.8	2.06
18	0.2	0.09	0.1	0.1	0.3	0.3	0.6	0.45	0.76	0.52	1.3	0.66
19	—	—	0.05	—	0.17	0.09	0.5	0.4	0.87	0.34	0.5	0.2
20	—	—	0.03	0.05	—	0.03	0.1	0.05	0.48	0.03	0.4	0.12
21	—	—	—	—	—	—	0.03	—	0.06	0.03	0.2	0.06
22	—	—	—	—	—	—	—	—	0.04	0.03	0.01	0.09
23	—	—	—	—	—	—	—	—	0.02	—	0.01	—

North-Western Area.

INTRODUCTION

The contributors to this report are:

Mr. E. Bertelsen, Copenhagen.
Dr. J. H. Fraser, Aberdeen.
Mr. Á. Friðriksson, Reykjavik.
Mr. Frede Hermann, Copenhagen.
Mr. R. Jones, Aberdeen.
Mr. Jón Jónsson, Reykjavik.
Mr. J. M. Lamont, Aberdeen.
Mr. A. D. McIntyre, Aberdeen.
Dr. B. B. Rae, Aberdeen.
Mr. A. Saville, Aberdeen.
Mr. Jens Smed, Copenhagen.
Mr. Unnstein Stefánsson, Reykjavik.
Mr. G. Timmermann, Reykjavik.
Dr. Å. Vedel Tåning, Copenhagen.

This report shows that work at sea and in the laboratories is again progressing normally along the pre-war lines.

The section on hydrography gives a general review of conditions during the summer months in practically all waters from the Faroes to West Greenland. It was evident that, in most areas except north of Iceland, the water transport in the cold currents was higher and in the warmer currents lower than in preceding years. Later in the year more normal conditions were probably established.

The review given by Mr. Jens Smed of alterations in surface temperatures over the whole area shows that a slight decrease in temperature occurred in the eastern part during the period 1945—50. A slight decrease in temperature was also observed in depths of about 200—700 metres west of the Faroes (see pp. 18—19, Mr. Hermann's report on the "Dana" section from Faroe to Greenland). The influx of Atlantic water through the Faroe-Shetland channel was rather superficial in August, not reaching deep down on the eastern side.

It is of special interest from a biological point of view that Mr. F. Hermann is able to show that the high temperatures in June on Fyllas Bank at West Greenland, in the years 1926, 1934, 1936 and 1947, coincided with the production of rich year-classes of cod, and that low temperatures in some other years coincided with poor year-classes. Temperatures of about 2°C. or over are followed by good year-classes, lower temperatures by poor year-classes. In this connection I might add that my log book from the cruise of H.M.S. "Islands Falk", 1924, shows that the bottom temperature on the Fylla Bank on 24. June was 2.50°C., and that, according to Dr. Paul M. Hansen's observations, that year's brood of cod was also a prolific one; these facts support the observations made by Mr. Hermann. It should certainly be easy to forecast brood strength of cod in Greenland waters if observations of the bottom temperature in June on Fylla Bank are alone sufficient basis for prediction of good or poor year-classes of this important fish. This coincidence ought to be studied in greater detail during the coming year, because relevant observations are not available for all years during the period 1924—1950.

The extent of plankton observations in the North-Western Area leaves much to be desired. It is of interest that studies in abundance of eggs and larvae are progressing, and that these are showing good years for gadoids and herring in the Faroe area.

The age-assessment, growth studies etc. of the different stocks of fish are also progressing, but it will still take some years before all important species are covered in this respect for all the different sub-areas. Mr. Jón Jonssón's short review of the cod stock at Iceland during the last 2—3 decades brings the information about this species up to date; Dr. Hansen has already done so for the Greenland waters.

Information on the present state of the haddock stock at the Faroes is given by Mr. R. Jones; other reports are:— on lemon sole at Faroe and West Iceland by Dr. B. B. Rae, on plaice at Iceland by Dr. Rae and Mr. Lamont, and on halibut at Faroe and Iceland by Mr. McIntyre. But the gap in our knowledge caused by the war is difficult to fill. The increase in the stock of haddock in Faroe waters during the war is illustrated by Mr. Jones' report as also is the post-war decrease, but, in the North-Western Area, this is the only report so far that indicates the beginning of a return to the pre-war state of affairs.

As to information about herring, I refer readers to very important observations from the area given in the Herring Committee, p. 118.

Å. Vedel Tåning.

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the northern North Atlantic during the Years 1945-50 and at Icelandic Coastal Stations during 1943-45.

Monthly anomalies of the surface temperature for both the areas and the stations indicated in Figure 1 were given, for the periods 1876—1939 and 1873—1942 respectively, in articles in the *Annales Biologiques*, vols. II—VI. A summary of these investigations has also been published[1]). Observations for the war years are available from the stations only. In the following report anomalies for the areas in post-war years will be given together with anomalies for the Icelandic stations during the years 1943—45.

For the areas, the data used were the temperature means for each month and each 1°-square published in the *Nautisk-Meteorologisk Årbog*. These means were compared to the grand monthly means for the period 1876—1915, published by RYDER[2]). The anomalies found in this way were then averaged over the various areas.

[1]) SMED 1949. C.P.I.E.M., Rapp. & Proc.-Verb., Vol. CXXV, p. 21.

[2]) RYDER 1917. Monthly Mean Temperatures of the Surface Water in the Atlantic, North of 50° N. Lat. (App. to Naut.-Meteor. Årbog). Copenhagen.

The results are given in Table 1 (see pp. 10/11) where monthly anomalies are recorded together with the numbers of observations on which they are based. A graphic presentation of the anomalies is given in Figures 2 and 3.

Table 2 records anomalies of the surface temperature at the 4 permanent stations on the coast of Iceland, viz., Vestmannaeyjar, Stykkisholmur, Grimsey, and Papey (stations Ve, St, Gr and Pa in Figure 1) during the years 1943—45. Monthly means, based on daily

Figure 1. Location of areas and stations.

Table 2. Monthly Anomalies (°C) of the Surface Temperature on Icelandic Coastal Stations (see Fig. 1) during the Years 1943-45.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Vestmannaeyjar													
1943	2.3	2.3	1.9	1.2	0.3	0.5	0.3	—0.1	1.1	0.7	1.6	2.1	1.2
1944	1.6	2.1	1.2	0.9	1.0	0.6	0.0	1.9	1.1	1.6	1.3	2.2	1.3
1945	0.6	2.2	2.0	1.4	1.4	0.3	0.6	—0.2	1.9	2.7	3.3	2.6	1.6
Stykkisholmur													
1943	—0.8	—0.4	0.8	0.5	—1.0	—1.1	—0.3	—1.8	—1.1	—0.8	0.1	1.4	—0.4
1944	—0.7	0.3	0.8	0.1	—0.4	—1.0	0.0	0.5	0.4	—0.4	—	—	0.0
1945	—1.4	—	1.9	1.9	0.4	—0.3	0.1	0.7	0.2	0.9	2.6	1.1	0.7
Grimsey													
1943	—	—	0.5	0.3	—0.1	—	—	0.2	0.5	0.2	—	—	0.3
1944	—0.6	—	—	—	0.4	0.4	—	—	1.7	1.5	1.0	0.4	0.7
1945	—0.2	0.7	1.2	0.9	1.4	1.2	2.7	2.2	1.3	0.7	0.6	1.5	1.2
Papey													
1943	—0.8	0.2	1.0	0.5	0.3	0.5	0.6	0.4	0.7	0.7	0.3	1.4	0.6
1944	—0.2	0.3	0.4	—0.1	0.4	0.0	0.1	—	—	0.7	0.5	1.2	0.3
1945	—0.5	1.1	2.0	1.5	0.8	0.6	1.5	1.6	1.6	2.2	2.6	1.6	1.4

Table 1. Monthly Anomalies (△°C) and Numbers (n) of Observations of the Surface Temperature in the Areas A-N (see Fig. 1) during the Years 1945—50.

Area		January		February		March		April		May		June		July		August		September		October		November		December	
	Year	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n
	1945	—	—	—	—	—	—	—	—	—	—	—	—	0.0	34	0.8	40	—0.6	72	0.4	64	—	—	—	—
	1946	—	—	—	—	—	—	0.2	7	1.1	48	0.7	38	0.0	87	0.0	18	0.4	73	1.4	15	0.2	18	—	—
A	1947	—	—	—	—	—	—	0.3	13	2.3	53	0.5	20	1.6	9	0.9	46	0.5	10	0.6	40	—0.9	21	—	—
	1948	—	—	—	—	—	—	0.1	35	0.3	53	1.2	120	1.5	27	1.4	123	2.0	78	1.0	41	0.0	11	—	—
	1949	—	—	—	—	2.0	1	—0.7	36	—0.5	54	0.0	84	—0.4	113	0.0	41	0.3	37	—0.3	29	—0.8	24	—	—
	1950	—	—	—	—	—	—	0.5	3	0.8	42	0.8	46	0.2	122	0.6	119	1.1	51	0.4	46	—0.1	18	—	—
	1945	—	—	—	—	—	—	—	—	—	—	—	—	—0.5	59	—1.3	35	0.1	21	—0.5	44	1.3	1	—0.5	1
	1946	—	—	—	—	—	—	0.7	59	0.5	78	0.4	40	—0.7	86	—0.5	30	—0.6	120	0.4	43	0.0	36	—0.4	6
B	1947	—	—	—	—	1.3	8	1.1	93	1.2	58	1.5	38	0.7	15	0.8	25	—0.1	30	0.1	57	0.1	46	0.3	7
	1948	—	—	—	—	—1.6	5	—0.5	87	0.5	78	1.0	60	0.2	29	0.5	66	0.6	65	0.0	46	—0.6	28	—1.6	10
	1949	—	—	—	—	—1.4	77	—0.9	97	—0.5	170	0.1	70	0.6	56	—0.6	69	—1.2	73	—1.2	50	—0.4	87	0.5	5
	1950	—	—	—	—	—0.2	36	0.8	46	0.7	124	0.5	78	0.6	75	0.0	29	—0.4	46	—0.7	53	—0.4	97	3.5	2
	1945	—	—	—	—	—	—	—	—	—	—	—	—	0.8	24	0.9	37	0.1	11	0.1	21	1.7	17	0.6	6
	1946	—	—	—	—	—	—	0.2	33	1.2	40	2.0	41	—0.1	30	0.1	13	—0.2	70	1.1	46	1.2	5	1.1	3
C	1947	—	—	—	—	1.2	14	0.7	17	1.7	20	1.0	28	1.4	23	0.2	15	—0.4	40	0.6	19	1.4	10	—	—
	1948	—	—	—	—	—0.4	2	—0.6	37	0.1	40	0.4	38	0.7	40	0.9	30	0.5	35	0.4	39	1.2	6	—	—
	1949	—	—	—	—	0.2	31	—0.4	18	—0.7	9	0.3	41	—0.1	18	—0.4	51	—0.6	79	0.4	39	0.6	5	0.3	1
	1950	—	—	—	—	0.5	13	0.2	9	—0.1	40	0.8	50	1.0	48	0.5	32	—0.2	60	—0.5	24	0.2	6	—	—
	1945	—	—	—	—	—	—	—	—	—	—	—	—	0.1	18	—	—	0.0	5	—1.1	3	1.1	12	—	—
	1946	—	—	—	—	—	—	0.6	43	0.0	29	0.7	11	—0.2	14	—0.7	21	—1.0	36	0.8	18	1.4	14	2.5	4
D	1947	1.3	7	—	—	0.5	1	0.1	49	0.8	23	0.5	25	1.7	1	—0.7	11	—1.5	11	0.0	16	0.3	26	0.7	4
	1948	3.5	2	—	—	0.0	6	—0.2	36	0.4	24	0.9	14	1.4	18	0.7	21	—0.3	15	0.1	14	—0.3	12	0.3	8
	1949	0.6	2	—	—	—0.2	63	—0.2	47	—0.4	51	0.1	9	—0.3	19	—0.8	23	—0.6	32	—0.1	32	—0.4	24	0.0	8
	1950	2.6	4	—	—	—0.1	34	0.0	38	0.3	40	0.5	25	0.6	20	—0.1	5	—0.5	6	—0.5	27	—0.6	51	—0.3	7
	1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1946	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—1.4	8	—0.3	16	1.2	17	—1.2	15	0.9	25
E	1947	—0.7	37	0.9	24	0.4	22	—0.3	36	—0.9	43	—1.4	87	—1.5	18	—1.5	21	—1.5	23	—0.7	30	0.0	35	1.2	27
	1948	1.8	42	0.6	15	0.7	23	—1.1	9	—0.2	8	—2.3	11	0.2	32	0.2	20	0.2	13	—1.0	5	—0.3	19	0.4	14
	1949	—0.1	9	—0.8	8	0.3	21	—1.2	25	—0.9	16	—1.3	33	—1.2	22	—1.3	54	—0.4	27	—0.6	32	—0.3	14	—0.3	24
	1950	1.4	5	—1.4	14	—1.5	32	—1.1	26	0.0	45	0.5	30	—0.6	22	—0.5	37	—0.6	29	—0.5	41	0.4	61	1.6	33
	1945	—	—	—	—	—	—	—	—	—	—	—	—	0.5	39	1.2	14	0.4	17	0.8	19	1.4	18	0.3	20
	1946	0.0	2	—	—	—	—	0.3	54	1.4	62	1.9	22	0.4	31	0.3	10	—0.4	40	1.2	59	1.8	10	0.4	16
F	1947	1.6	2	—	—	0.0	25	—0.3	49	1.0	28	0.7	41	0.2	25	—0.1	29	0.2	25	0.3	14	—0.4	30	0.2	19
	1948	—	—	—	—	0.2	21	—0.6	48	—0.2	61	0.3	55	0.1	46	0.3	33	—0.5	27	—0.4	58	0.1	19	0.3	13
	1949	—0.1	1	0.6	4	—0.1	63	—0.6	31	—0.9	66	0.3	45	—0.1	33	—0.3	34	—0.1	63	0.3	51	—0.3	24	—0.5	15
	1950	—	—	—0.1	4	0.3	50	0.0	44	0.2	69	0.0	62	0.6	77	0.7	39	—0.3	44	—0.3	54	—0.4	55	0.6	1
	1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—3.4	2	2.0	18	1.4	2	3.7	1	2.1	4
	1946	2.5	4	—	—	1.7	5	0.2	2	1.4	10	1.4	10	—1.3	23	0.4	5	0.8	27	0.8	11	2.8	8	1.7	17
G	1947	2.1	18	—	—	0.6	2	1.0	1	1.1	3	—0.3	2	—0.5	5	0.4	26	—0.4	27	—0.6	12	1.7	5	1.2	3
	1948	2.3	3	2.1	4	1.1	4	—1.0	7	—0.1	6	0.5	12	0.4	58	0.8	6	—0.6	14	—0.4	12	1.1	14	0.9	5
	1949	1.3	9	2.0	3	0.6	2	0.0	5	—1.0	2	—	—	0.4	15	—0.3	23	—1.4	42	0.6	11	0.2	11	0.7	6
	1950	0.4	6	1.7	8	0.3	7	0.3	8	1.1	9	0.2	13	0.4	29	0.6	8	0.7	13	0.0	10	0.6	6	0.1	6

Area	January		February		March		April		May		June		July		August		September		October		November		December	
Year	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n
1945	—	—	—	—	—	—	—	—	—	—	—	—	0.3	39	1.6	15	1.6	37	1.5	27	2.1	25	0.4	31
1946	1.6	20	1.0	11	1.3	22	0.6	113	1.7	90	0.6	53	0.6	71	1.2	27	0.8	72	1.2	94	1.6	45	1.3	59
1947	1.3	52	1.1	20	0.6	46	0.3	75	1.0	55	0.5	64	0.2	55	0.8	69	0.5	55	0.5	42	0.5	91	0.7	41
H 1948	0.6	21	0.9	24	0.4	64	—0.3	76	0.4	98	0.1	94	—0.2	89	0.3	55	—0.4	61	—0.5	74	0.4	65	0.3	43
1949	0.8	40	0.6	20	—0.2	72	0.1	40	—0.5	92	0.7	70	0.7	73	—0.1	82	0.9	109	0.5	92	0.4	55	0.3	41
1950	1.0	32	0.2	26	0.3	108	0.2	101	0.7	118	0.2	129	0.6	143	1.5	84	0.0	86	0.0	92	—0.1	62	0.2	26
1945	—	—	—	—	—	—	—	—	—	—	—	—	2.1	10	1.1	1	—	—	—	—	2.5	3	2.2	3
1946	1.4	3	1.3	7	1.6	10	1.3	5	1.7	14	1.3	7	1.3	11	1.8	6	2.0	11	1.6	7	2.0	10	2.7	5
1947	1.7	7	1.5	13	0.7	14	1.2	2	1.2	7	0.7	11	0.8	49	1.3	12	2.0	11	0.6	12	1.3	6	1.5	7
I 1948	1.2	6	1.2	7	1.0	7	0.3	9	0.6	8	2.0	15	0.6	33	0.8	6	0.7	44	0.2	6	1.3	23	1.7	6
1949	0.9	11	0.7	7	1.2	6	0.4	5	0.4	3	0.1	6	0.4	41	0.7	16	1.6	22	1.5	9	1.5	12	1.0	8
1950	0.6	11	0.0	9	0.7	10	0.5	10	1.0	13	0.8	9	0.5	46	1.0	40	1.9	20	0.7	11	1.0	2	0.8	7
1945	—	—	—	—	—	—	—	—	—	—	—	—	0.1	45	2.0	9	1.0	31	2.0	19	1.3	25	1.2	17
1946	0.7	25	1.2	5	0.9	17	0.3	98	0.8	43	0.6	52	0.9	37	0.9	46	0.4	56	1.1	82	1.0	32	1.1	39
1947	1.2	19	1.0	21	0.4	52	0.1	27	0.8	40	0.4	93	1.8	95	1.9	41	1.1	75	0.8	30	0.6	54	0.7	43
J 1948	—0.1	28	1.0	27	0.8	47	0.7	48	0.9	50	0.6	75	0.2	78	0.3	91	0.2	70	0.3	57	0.4	47	1.0	43
1949	0.6	33	1.3	22	0.4	49	0.8	23	0.3	60	0.6	44	0.9	95	0.4	66	1.4	79	0.8	50	1.0	40	—0.1	38
1950	1.0	31	0.4	22	0.6	57	0.7	59	0.7	66	0.1	107	0.9	96	1.3	97	1.0	91	0.3	54	0.0	30	0.0	20
1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.5	7	—	—	1.4	6
1946	1.2	6	1.0	6	1.3	12	—	—	0.9	13	0.2	21	0.0	30	0.8	21	0.8	33	0.7	42	1.5	14	0.8	38
1947	0.7	28	0.1	18	—0.2	12	0.2	28	0.3	31	0.6	40	0.9	21	1.9	21	1.6	20	0.8	23	0.4	39	1.1	23
K 1948	0.6	23	0.7	17	0.8	32	1.1	18	0.7	34	0.4	54	—0.2	35	—0.1	22	—0.2	45	—0.3	29	0.0	13	1.6	23
1949	0.9	29	1.1	11	0.7	15	0.7	18	0.0	23	0.6	20	1.2	26	0.2	27	1.2	48	0.9	30	1.1	31	0.9	31
1950	1.1	13	0.7	14	0.5	44	0.5	45	0.7	57	0.4	51	0.7	46	1.4	39	0.7	41	0.4	57	—0.1	47	0.0	18
1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.4	3
1946	—	—	—	—	2.0	3	1.4	12	2.1	11	0.6	13	—0.1	16	0.3	28	0.8	25	0.7	48	1.6	15	0.9	18
L 1947	0.7	25	1.4	24	0.6	21	1.0	45	0.6	41	0.4	76	0.4	26	1.0	19	—0.1	16	0.7	26	0.8	29	1.5	15
1948	1.0	16	—0.7	14	1.8	19	—0.1	13	0.2	12	0.1	16	0.2	29	—0.5	28	—0.5	26	—0.4	15	0.4	17	0.7	18
1949	—0.6	6	0.9	15	0.7	12	0.1	22	—0.1	9	1.0	22	0.5	26	—0.1	17	1.0	33	0.7	16	0.3	23	0.0	22
1950	0.7	16	0.3	13	0.3	22	0.1	37	0.9	48	0.3	24	1.3	26	0.8	21	0.8	20	0.2	42	0.1	55	—0.2	26
1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.1	4	—	—
1946	—	—	—	—	—	—	0.3	34	0.8	2	0.8	12	0.1	11	—0.2	27	—0.3	32	0.6	39	1.6	18	2.0	12
M 1947	0.4	15	1.7	19	0.5	9	0.4	50	—0.1	49	—0.4	42	—0.6	11	—0.8	14	—1.0	16	0.1	28	0.1	30	0.8	21
1948	1.8	20	—0.3	11	1.7	11	—0.2	22	0.9	4	—0.7	2	0.4	20	0.2	27	—0.3	22	0.3	10	0.2	27	0.5	18
1949	0.9	10	—0.1	14	—0.1	20	—0.5	23	—0.5	16	—0.2	14	—0.3	17	—0.8	18	0.5	27	0.1	16	—0.1	27	—0.7	21
1950	0.1	12	0.2	6	—0.1	27	—0.8	32	0.4	26	0.5	25	0.3	16	0.0	27	0.0	14	—0.7	41	—0.5	48	—0.3	26
1945	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1946	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—0.9	5	—0.7	5	2.3	1	—	—	—	—
N 1947	—0.4	7	0.0	8	0.0	14	—0.1	17	—0.9	15	—1.5	32	—0.9	16	—1.3	5	—0.8	2	0.4	2	1.0	1	—	—
1948	—	—	0.0	7	0.2	3	—1.2	13	0.0	10	—0.9	13	—0.2	16	0.7	3	—	—	—	—	—0.5	1	—	—
1949	—0.5	1	—1.3	12	1.3	6	—1.0	8	0.6	6	—0.5	7	—0.7	11	—0.4	4	—0.3	4	—	—	—	—	—0.5	3
1950	—	—	—0.5	8	0.0	10	—0.3	15	0.1	31	0.9	7	—0.1	5	—0.7	5	—1.5	10	0.5	3	—	—	—	—

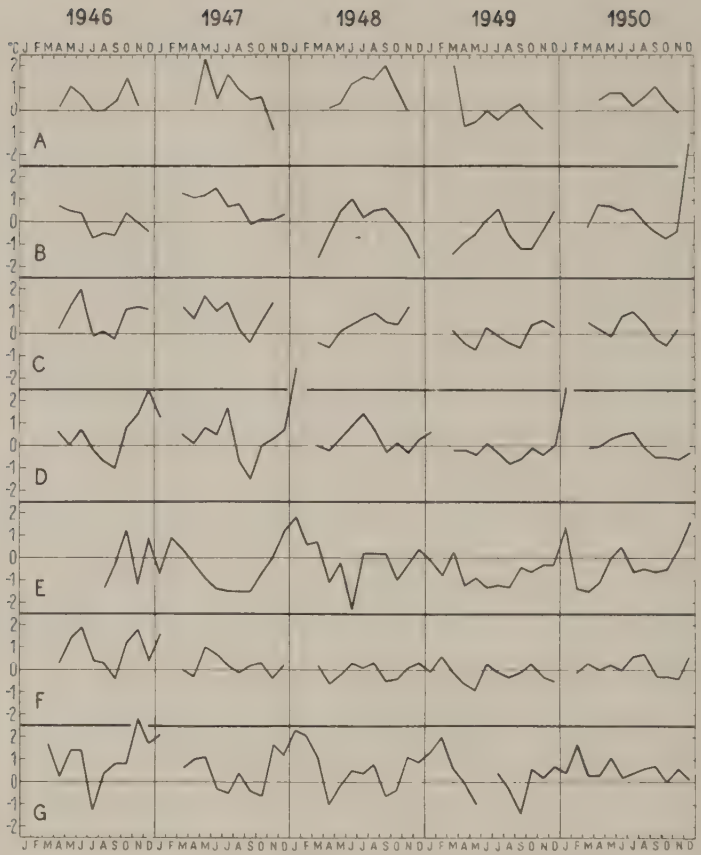


Figure 2. Monthly anomalies of the surface temperature in the areas A-G (see Fig. 1) during the years 1946—50.

observations, were compiled from the relevant issues of *Vedrattan*. The anomalies given in Table 2 were obtained by comparison of these monthly means with the grand monthly means for the period 1876—1915, published by RYDER (*loc. cit.*).

From the tables and graphs it is seen that positive anomalies are still predominant in most areas in post-war years. In the two southernmost areas, E and N, however, which in a period of years immediately before the war showed no marked preponderance of positive anomalies, negative anomalies are now predominating. There is, also, in most of the areas where positive anomalies still predominate a decline during the period here considered.

Table 3. Yearly Averages (°C) of the Monthly Anomalies of Surface Temperature in the Areas A-N (see Fig. 1).

Year	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1945 . . .	0.2	—0.2	0.7	0.0	—	0.8	1.2	1.2	2.0	1.3	1.4	1.4	1.1	—
1946 . . .	0.5	0.0	0.7	0.5	—0.2	0.7	1.1	1.1	1.7	0.8	0.8	1.0	0.6	0.2
1947 . . .	0.7	0.7	0.9	0.3	—0.5	0.3	0.6	0.7	1.2	0.9	0.7	0.8	0.1	—0.4
1948 . . .	0.9	—0.2	0.4	0.6	—0.1	0.0	0.6	0.2	1.0	0.5	0.4	0.2	0.4	—0.2
1949 . . .	0.0	—0.5	0.0	—0.2	—0.7	0.2	0.3	0.4	0.9	0.7	0.8	0.4	—0.2	—0.3
1950 . . .	0.5	0.4	0.3	0.2	—0.2	0.1	0.5	0.4	0.8	0.6	0.6	0.5	—0.1	—0.2

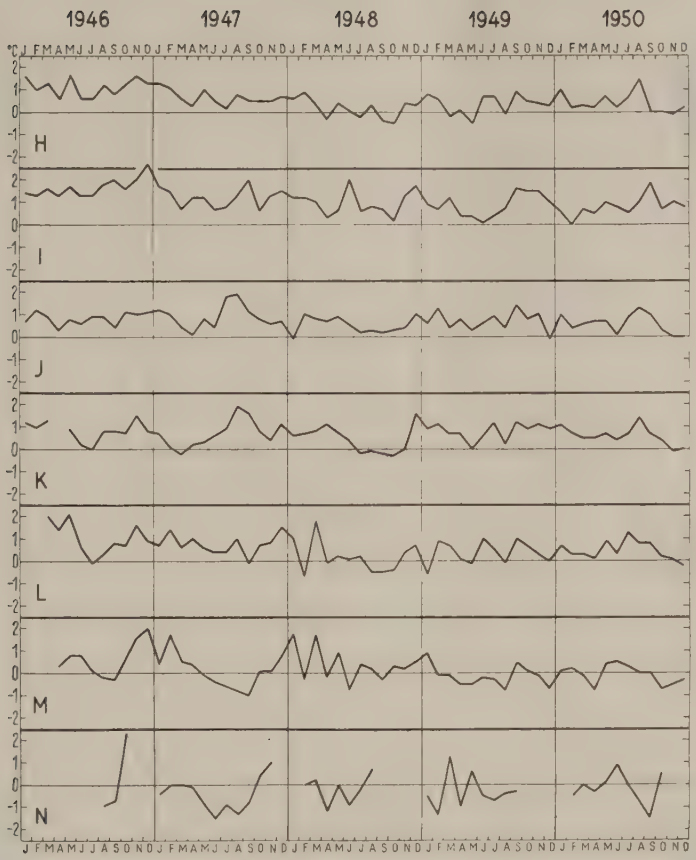


Figure 3. Monthly anomalies of the surface temperature in the areas H-N (see Fig. 1) during the years 1946—50.

These features are illustrated by computing yearly averages of the monthly anomalies given in Table 1. The results are recorded in Table 3.

JENS SMED.

Hydrographic Conditions in the South-Western Part of the Norwegian Sea.

Area north of the Faroes.

In connection with herring investigations extensive hydrographic work was carried out by the R/V "Dana" in the beginning of June and the beginning of August.

Figure 4 shows the position of the stations and Figures 5, 6 and 7 the distribution of temperature and salinity at the surface, at 20 metres and at 100 metres. The main features in these maps are the same as those found in August 1948 (Ann. Biol. 1948, p. 19) with a warm Atlantic current flowing into the Norwegian Sea north of the Faroes and the East Icelandic current appearing as a tongue of cold water with relatively low salinity. The East Icelandic current, however, extended considerably farther to the south in 1950 than in 1948 and nearly cut off the Atlantic current north of the Faroes. The southernmost part of the cold current was found at exactly the same position in both June and August. The limit between the two currents was, at this position, very sharp. The northernmost part of the core of the East Icelandic Polar current was, in August 1950, found farther east than in 1948. A tongue of relatively warm and saline water from the south separated this current from the

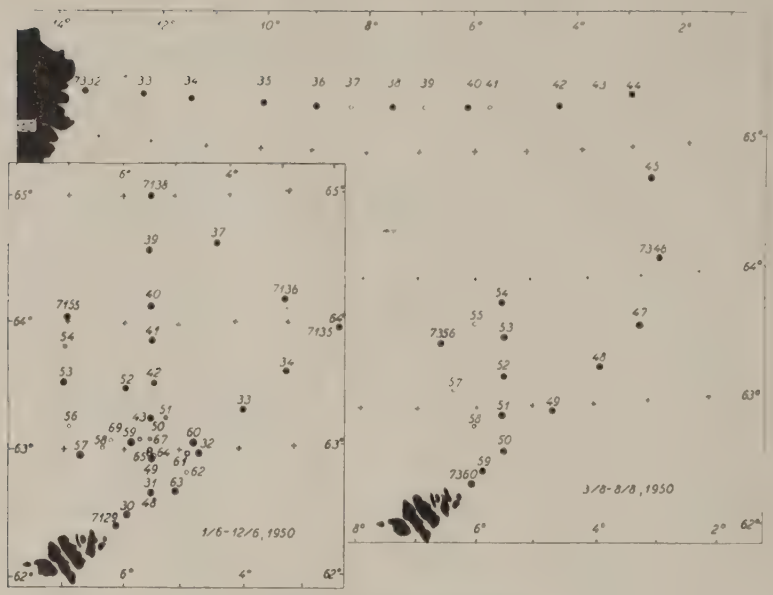


Figure 4. Location of stations.

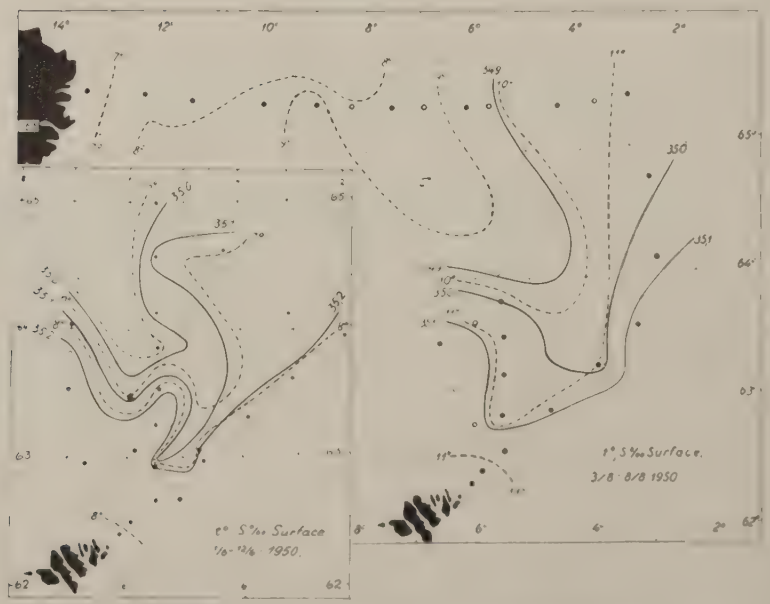


Figure 5. Distribution of temperature and salinity, surface.

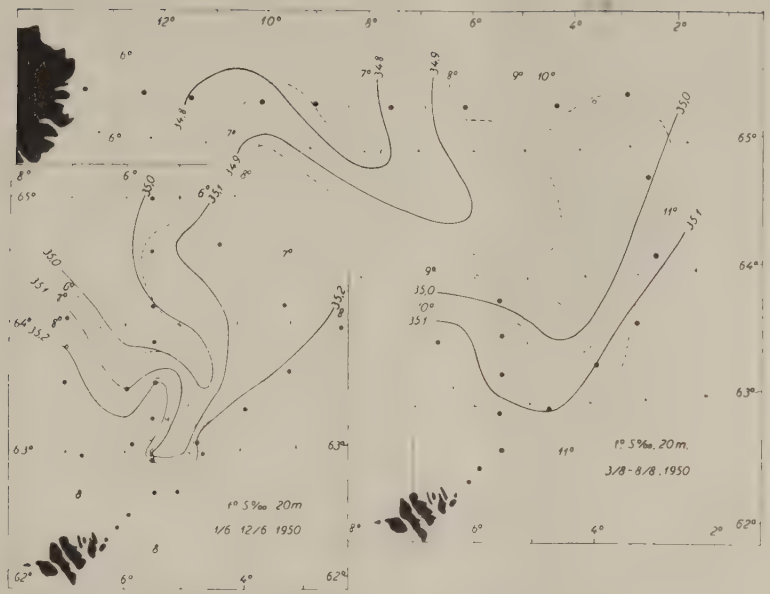


Figure 6. Distribution of temperature and salinity, 20 metres.

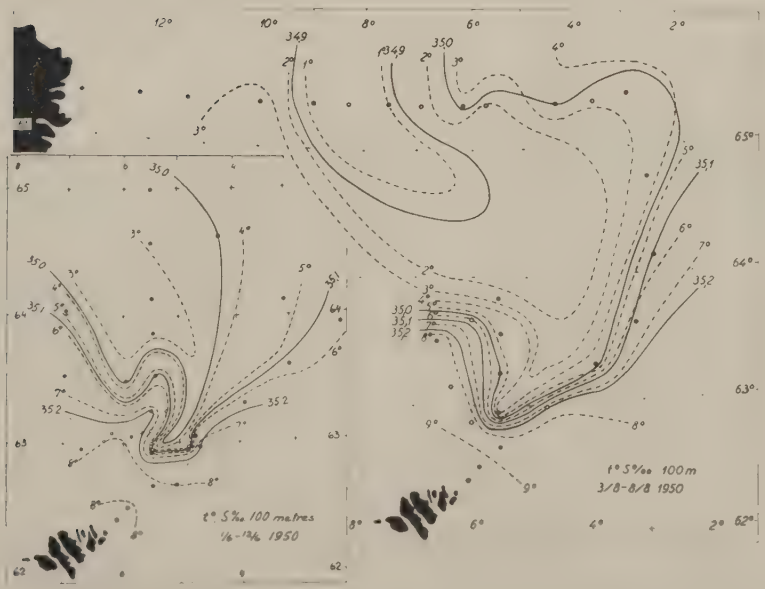


Figure 7. Distribution of temperature and salinity, 100 m.

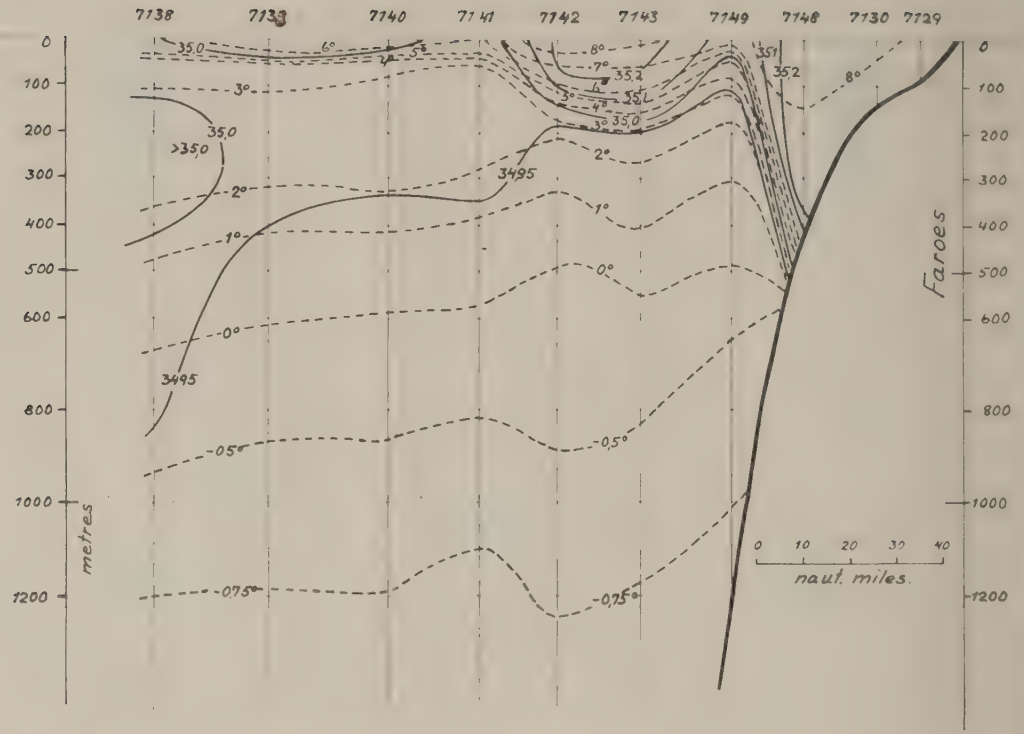


Figure 8. Section from the Faroes northwards, 2.—10. June 1950.

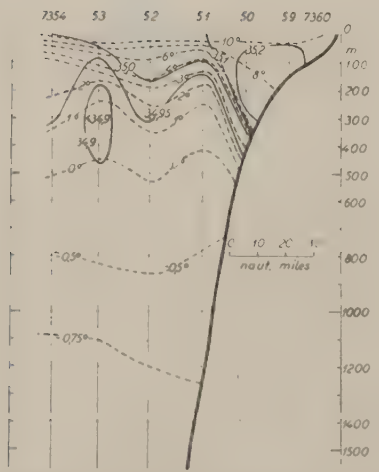


Figure 9. Section from the Faroes northwards, 7.—8. August 1950.

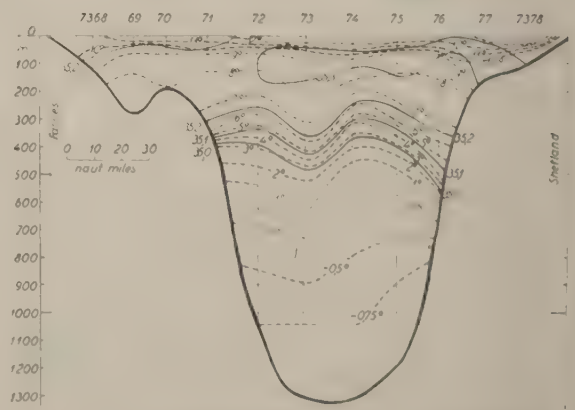


Figure 12. Faroe-Shetland section, 17.—19. August 1950.

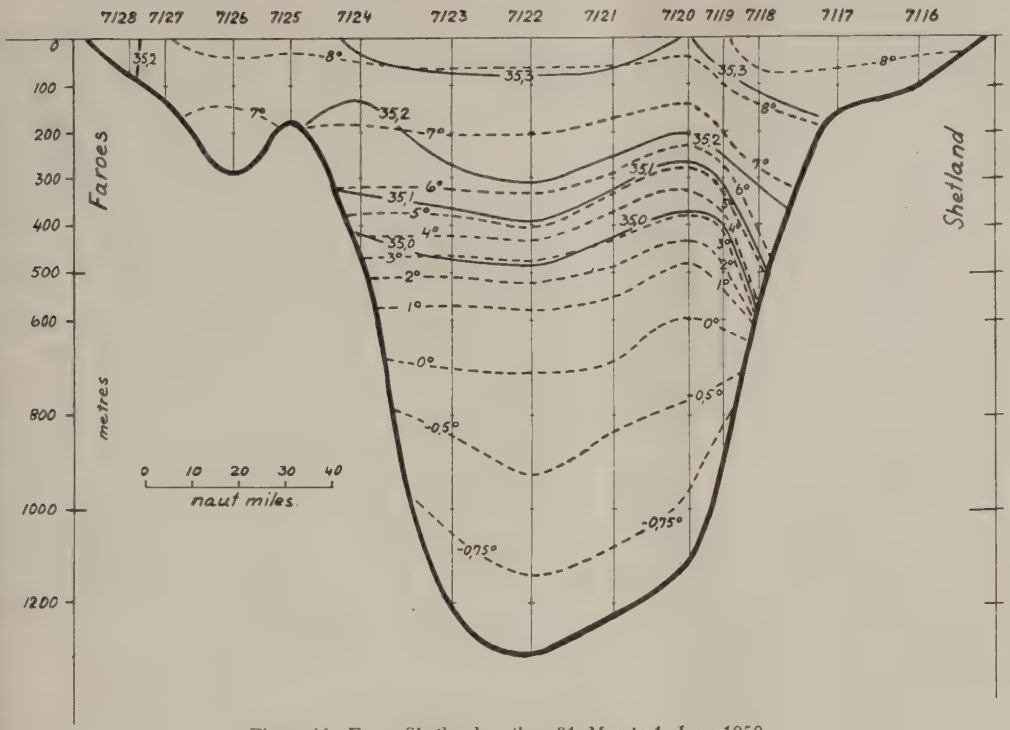


Figure 11. Faroe-Shetland section, 31. May to 1. June 1950.

Figure 10. Seydisfjord section, 3.—5. August 1950.

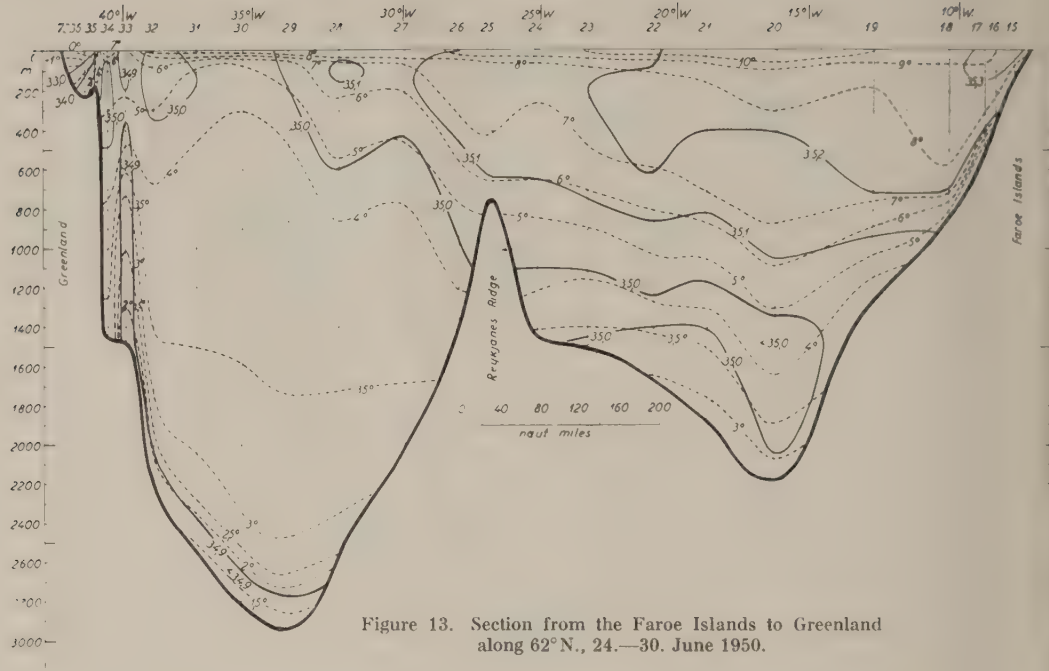


Figure 13. Section from the Faroe Islands to Greenland along 62° N., 24.—30. June 1950.

coastal water off East Iceland (see Fig. 10, St. 7335).

The hydrographic conditions are further illustrated by the sections (Figs. 8, 9 and 10).

The Faroe-Shetland section.

Figures 11 and 12 show the Faroe-Shetland section which was worked from 31. May to 1. June and from 17. to 19. August. The quantities of warm Atlantic water were relatively small in both sections and the distribution of temperature and salinity indicates a rather low value of inflow of Atlantic water.

FREDE HERMANN.

Section from the Faroe Islands to East Greenland.

Figure 13 shows the section worked by the R/V "Dana" between the days 24. and 30. June. The figure clearly shows the very pronounced difference between the areas east and west of the Reykjanes Ridge, the characteristic feature of the basin east of this ridge being the very thick layer of warm and saline water, while subarctic water with salinities between 35.0 and 34.9‰ extended over the major part of the western half of the section.

Comparison, in the eastern part of the section, with the conditions found in the years 1938, 1947 and 1948 shows a small decrease in temperature and salinity in the layers between 200 to 600 metres (about 0.°3) and a small increase in temperature above and below this layer. Relatively low bottom temperatures on the slope off the Faroes were possibly due to an inflow of cold deep water from the Norwegian Sea over the Faroe-Iceland ridge.

In the Irminger Sea we find the relatively warm and saline Irminger Current moving northward over and to the west of the Reykjanes Ridge. A salinity maximum situated at St. 7228, about 160 n.miles west of the Reykjanes Ridge, indicates that a branch of the Irminger Current goes southward at this locality so that the Irminger Current forms a cyclonic circulation in the eastern part of the Irminger Sea.

The southgoing branch of the Irminger Current with salinities exceeding 35‰, which is generally found off the slope of East Greenland, was much less pronounced than in the year 1948, and, at St. 7233, the current was

eparated into two parts by a tongue of water with salinities less than 34.9‰ and with low temperatures in the deeper layers. The low salinity of this tongue and of the deepest layers in the Irminger Sea shows that this water cannot originate from the sub-arctic water filling the major part of the Irminger Sea basin. Water of the same type is generally found north and east of Iceland and an outflow of this water must have taken place west of Iceland and to the slope off East Greenland and to the deepest part of the Irminger Sea.

The Arctic East Greenland current was, at this season, reduced to a narrow strip about 30 miles broad along the coast.

Phosphate determinations carried out on the upper layers of water at all the stations showed relatively high contents of phosphate except in the East Greenland current. The central part of Irminger Sea was especially rich in phosphate, the concentration in the surface water reaching 0.7 μg.-at/l. This indicates that the Irminger Sea may be an area of rich plankton production.

FREDE HERMANN.

Hydrographic Conditions north of Iceland 1950.

In late July and August, hydrographic investigations were carried out in the waters off the north coast of Iceland. Three of the sections examined will be discussed in this report. The location of the stations is shown in Figure 14.

The section off Kögur (Fig. 15) was worked at the end of July. The extent of Atlantic water was about twice what it was in August 1949 (Ann. Biol. for 1949), and the temperatures on the shelf were considerably higher. The amount of Polar water, however, was much less than in 1949 as is seen from the much higher salinity values in the surface layers. On the other hand, the intermediate Arctic water was considerably warmer and more extensive. The relatively great strength of this undercurrent might have been due to the comparatively large volumes of Atlantic water observed in the area north and west of Spitzbergen in early 1949[1]).

The section off Siglufjördur was extended north this year to Lat. 68°30′ N. The influx of Atlantic water into this section began at an

[1]) BIRGER RASMUSSEN: Notes on the Ice Conditions in Greenland Waters in 1949. Ann. Biol., Vol. VI (1949), 1950.

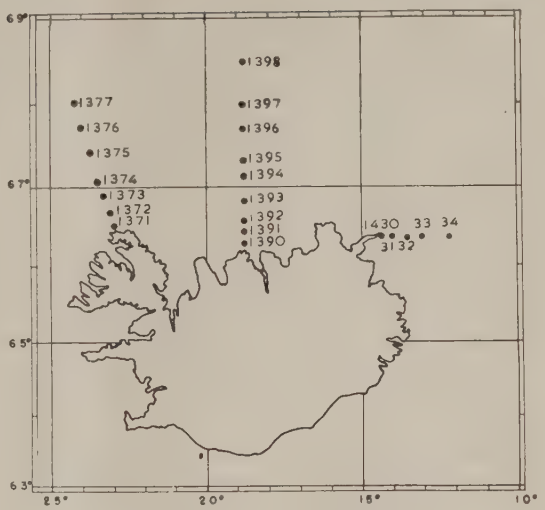


Figure 14. Location of the Stations.

unusually early date in 1950, being observed in the section in late May. In early August (Fig. 16) it was observed in intermediate depths between about 75 and 250 m. on the first three stations. On the fourth station (1393) it was not observed, but farther north it again appeared as a thin layer between 100 and 150 m. In the area off Siglufjördur, Atlantic water extended northwards to Lat. 67°40′. On the two outermost stations Polar water appeared in the surface layers. This water, however, was mixed with Arctic water whereby its salinity was increased. This Polar water rested on Arctic water which was relatively warm, particularly at the northernmost station. The Arctic intermediate water at this place was undoubtedly the same type of water as was observed in the intermediate layers in the Kögur section.

Figure 17 shows the Langanes section on 20.—21. August.

In this section also the temperature on the shelf was much higher in 1950 than in the previous year. The salinity was between 34.9 and 35.0‰ and the temperature did not fall below 3°C. on the first three stations. This must have been due to some influx of Atlantic water which might have increased later in the summer. Between St. 1433 and St. 1434 the isotherms rose upwards and the salinity was somewhat reduced. The outermost station was probably situated near the core of the East Icelandic current.

UNNSTEINN STEFÁNSSON.

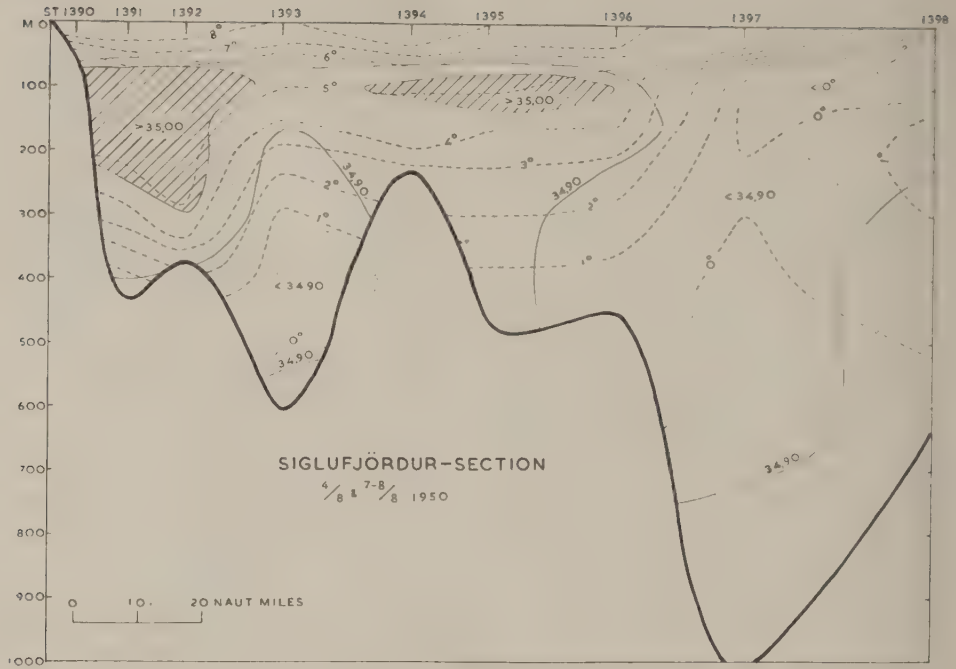


Figure 16.

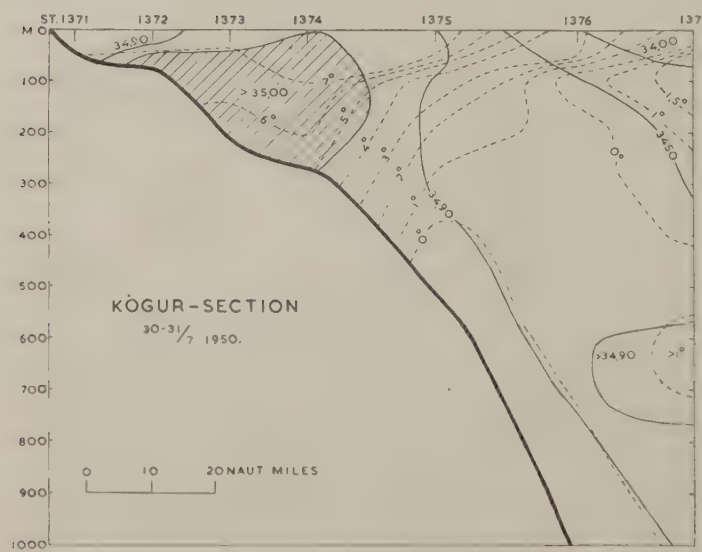


Figure 15.

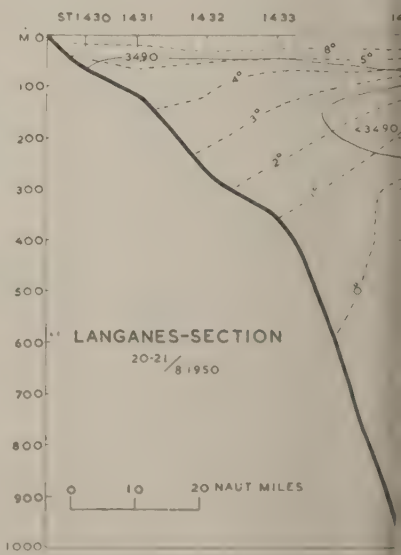


Figure 17.

Hydrographic Conditions off the West Coast of Greenland, 1950.

With remarks on the influence of temperature on cod year-classes.

During the summer of 1950 the sections shown in Figure 18 were worked partly by the Danish F.R.S. "Dana" under the leadership of Å. Vedel Tåning and partly by the Royal Danish Survey ship "Heimdal" under command of Captain Axel Schmidt, R.D.N.

The sections Ia, IIb, IIIb, IVb, V and VI were worked by "Dana" during the period 4.—15. July, the sections IIa, IIIa, IVa by "Heimdal" from 17. May to 1. June and sections Ib, IIc, IIIc, IVc and VII by "Heimdal" between 31. August and 27. September. The sections are shown in Figures 19 to 25.

Although the year followed the extraordinarily cold year 1949, the temperatures over the banks were about normal. Off the edge of the bank, however, cold water was present throughout the summer and, off the banks, the warm undercurrent was, especially in the northernmost sections, less pronounced than has been usual in recent years. For comparison, the 1949 sections are given in Figures 26—28.

Section I, off Frederikshaab (Figure 19).

The Arctic component of the West Greenland current was, in July, relatively very extensive, but its temperature was not very low. At the end of August this component was much reduced and, on account of summer heating and mixing with the warm Atlantic component, it had nearly lost its Arctic character. Both the temperature and the salinity of the Atlantic component, which occupied the deeper and western part of the section, increased considerably between the beginning of July and the end of August.

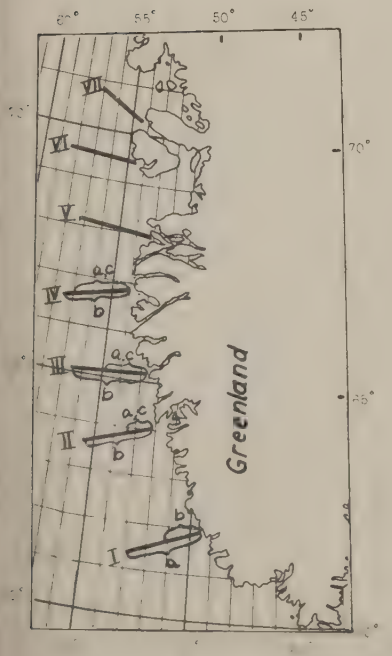


Figure 18. Location of sections.

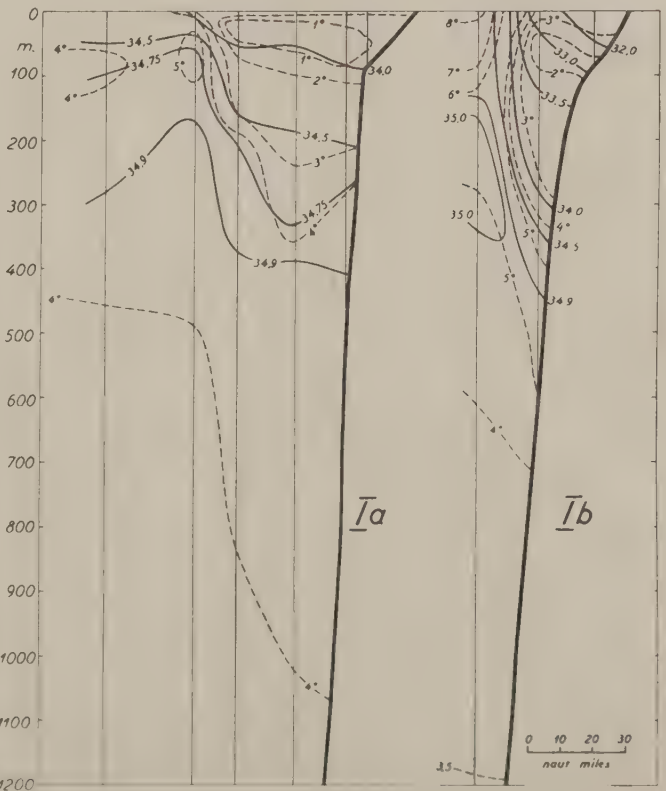


Figure 19. Sections off Frederikshaab, a, 4. July; b, 31. August 1950.

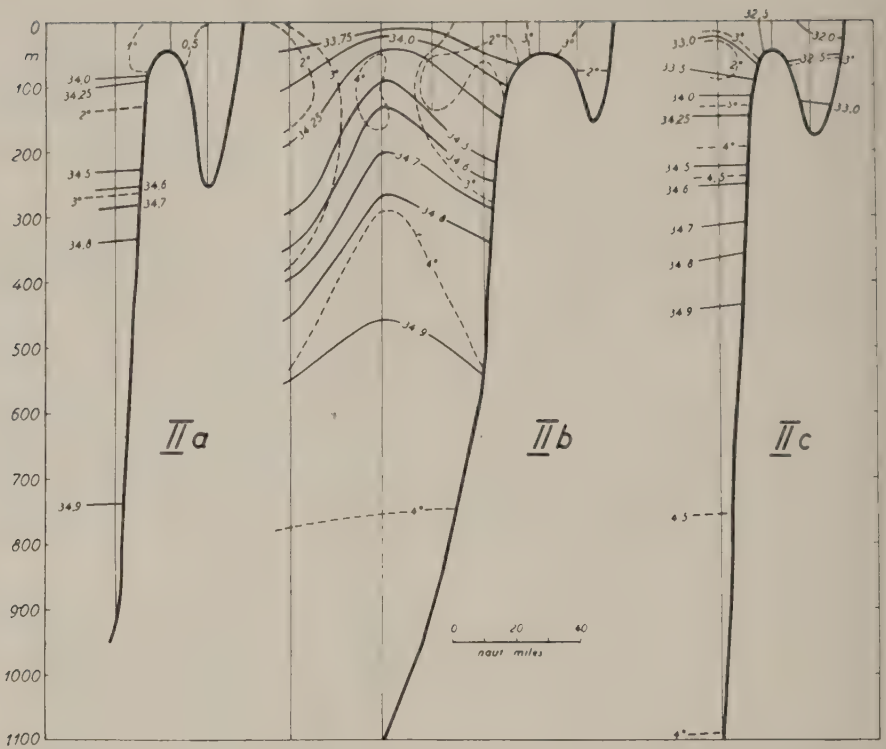


Figure 20. Sections across Fyllas Banke, a, 17. May; b, 5.—10. July; c, 1. September 1950.

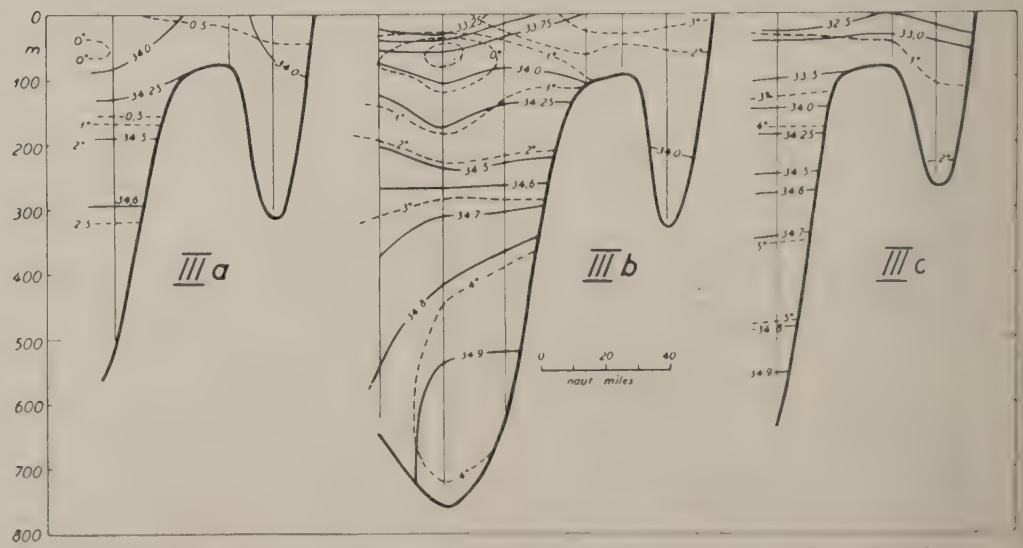


Figure 21. Sections across Lille Hellefiske Banke, a, 18. May; b, 7. July; c, 29. September 1950.

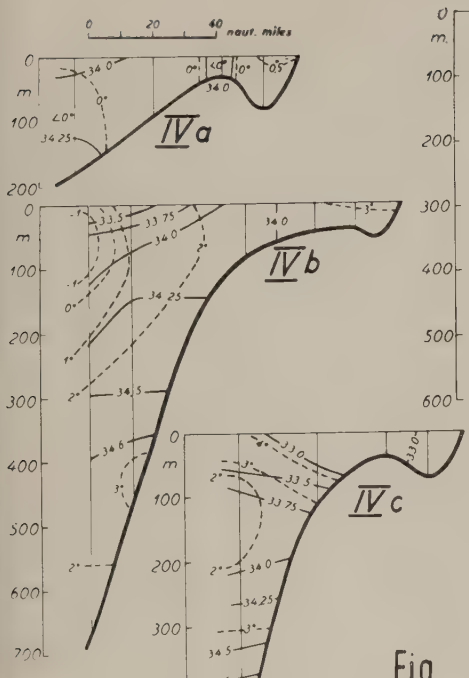


Fig. 22

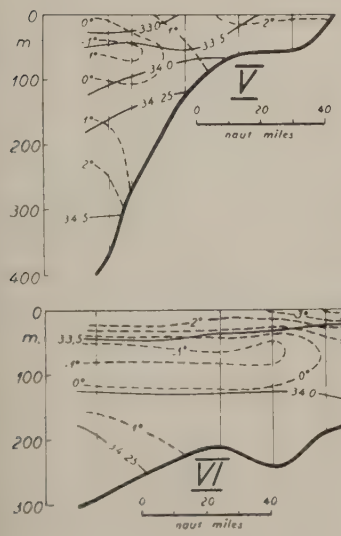


Fig. 23

Fig. 24

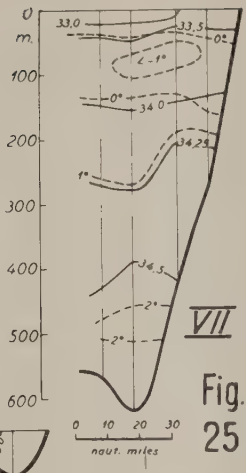


Fig. 25

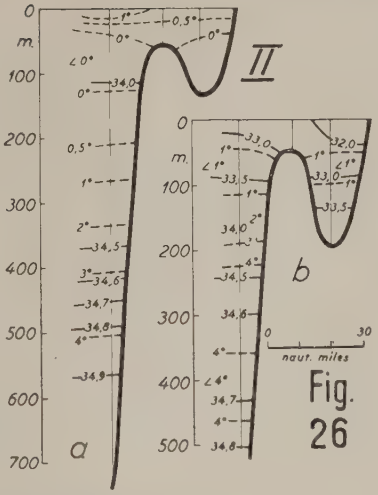


Fig. 26

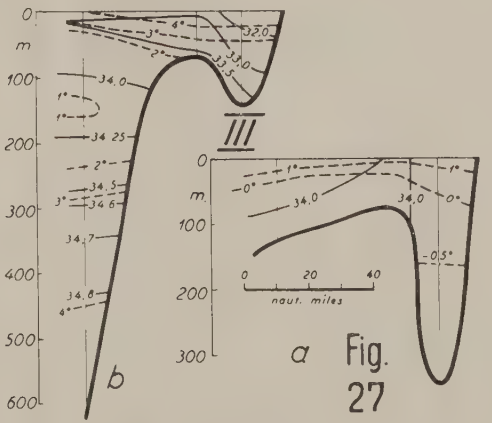


Fig. 27

Fig. 28

Figures 22 to 28. Various sections from 1949 and 1950.

Figure 22. Across Store Hellefiske Banke, a, 31. May; b, 8. 9. July; c, 15. September 1950.

Figure 23. Off Egedesminde, 10. July; Figure 24. Section Off Disko, 14.—15. July; Figure 25. Hareo, 8. September 1950.

Figure 26. Across Fyllas Banke, a, 2. June; b, 6. September 1949.

Figure 27. Across Lille Hellefiske Banke, a, 1. June; b, 2. September 1949.

Figure 28. Across Store Hellefiske Banke, a, 31. May; b, 1. September 1949.

Section II, across Fyllas Banke (Figure 20).

This section was worked three times during the period 17. May to 1. September. In May the temperature over and to the east of the bank was rather low, from 0.7° to 0.1°, but over the bank it rose rapidly to the normal. Off the bank cold water was still found in July and September between 50 and 100 m. In the warm undercurrent outside the bank a pronounced increase in temperature and salinity is found each year from early summer to autumn: this increase seems to have occurred later than usual in 1950. The temperature did not reach 5° at any depth on the September station off the bank. Comparison with previous years is difficult since the observations were taken in different months. June is the month with the greatest number of observations and the figures below give the bottom temperatures over the bank in this month, arranged in order of increasing temperature. Observations in brackets are interpolated from neighbouring months and must be treated with reserve.

Date June	Year	t°	Date June	Year	t°
1	1938	— 0.04	(10)	1950	(1.8)
2	1949	0.1	10	1936	1.95
13	1925	0.8	12	1926	2.21
(10)	1948	(1.30)	24	1934	2.69
2	1937	1.34	13	1947	3.39
18	1928	1.77	Mean		1.6

Remarks on the influence of temperature on the cod year-classes.

It is remarkable that the highest temperatures, i.e., from the years 1936, 26, 34 and 47, coincide with the best cod year-classes of recent years. According to Paul Hansen, the 1934 and 1936 year-classes were of major importance in the Greenland fisheries over the last ten years, and small cod of the 1947 year-class have appeared in large shoals along the coast of West Greenland in the last three years. The 1926 year-class was also a very rich one.

This indicates that the temperature at the spawning and hatching time is of great importance for the strength of the year-class. It is remarkable that the 1947 year-class has survived the very cold year 1949 (see Figs. 26—28) without any considerable loss, just as the 1936 year-class survived the cold year 1938. A fairly short cold period seems not to affect to any considerable degree either the stock of older or that of small cod past the larval stage.

Section III, across Lille Hellefiskebanke (Figure 21).

The main features in this section were the same as those found in the Fyllas Banke section with about normal temperature conditions over the bank. It is remarkable that cold water originating from the Canadian Polar current was found in May and July about 30 miles west of the bank. In the September section the temperature of the warm undercurrent had increased considerably and was higher than that found in the Fyllas Banke section worked 26 days earlier.

Sections IV to VII.

In these sections the influence of the Canadian Polar current is more pronounced. The westernmost stations in section IV to VI are situated at the edge of the west-ice. The temperatures over the banks were about normal but the warm undercurrent, especially in the three northernmost sections, was considerably colder than in the years 1948 and 1949. The maximum temperatures of this current at section VII were as follows: 30.7 1948, 3°4; 26.8 1949, 2°65; 8.9 1950, 2°02. A continued decrease may be serious, because it may affect the shrimp fishery in Disko Bay.

Frede Hermann.

Plankton.

Plankton in Faroe-Iceland Waters.

In addition to the work on haddock eggs and larvae carried out on the Faroe Plateau and reported separately by Mr. A. Saville, plankton collections have been taken by the Scottish research vessels "Explorer" and "Scotia" both on the plateau and along the lines Faroe-Shetland and Faroe-Hebrides in March April, May, June, July/August, September, and November. The "Scotia" also worked a series of stations from Faroe to Iceland, along the south coast of Iceland and thence back to the Hebrides in September. The nets used were the International Standard fine silk, Hensen egg-net and 2-metre ring-net hauled vertically, and 1-metre nets towed horizontally or obliquely from depths up to 1500 metres.

Faroe Plateau.

The dominant diatom species changed during the year from mainly Coscinodiscus in March, *Thalassiothrix nitzschioides, Thalassiosira gravida* and Lauderia in May to *Th. gravida* and *Rhizosolenia spp.* in the summer with *Nitzschia seriata* offshore.

Calanus finmarchicus, Meganyctiphanes norvegica and *Thysanoessa longicaudata* were abundant to the north of Faroe in March, but were not generally abundant on the Faroe plateau until April to June when Calanus became extremely abundant, collections from the 2-metre ring-net usually containing more than 10,000 individuals in a 100-metre haul, although this species later became much reduced. Other species commonly present included *Pleuromamma robusta, Euchirella rostrata, Euchaeta norvegica,* Laodicea, Mitrocomella and *Sagitta elegans,* which were most abundant in May and June. *Aurelia aurita* increased steadily from early summer to the autumn when large quantities were present.

Faroe – Shetland and Faroe – Hebrides.

There was little phytoplankton over deep water in the early spring, but in the summer green collections with *Rhizosolenia spp., Chaetoceros spp.* and many Tintinnoidea were taken. The oceanic copepods Rhincalanus and Eucalanus were found with Euchaeta and Pleuromamma on both lines, but Calanus only occurred in numbers between Faroe and Shetland. The collections from the Faroe-Hebrides line were very much richer in exotics than from Faroe-Shetland and large numbers of bathypelagic and surface species of copepods, medusae, siphonophores etc., were taken. *Sagitta serratodentata* was common only at the southern end of the lines while *S. maxima* and *Eukrohnia hamata* were found almost throughout. Aglantha and Arachnactis larvae were very numerous only over deep water. Salps and doliolids were present in summer and autumn.

Faroe – Iceland – Hebrides (September only).

Rich phytoplankton was found north-west of Lousy Bank where a large mixture of species occurred. Doliolids, Aglantha and Arachnactis larvae were especially abundant SE. of Lousy, and large collections of bathypelagic species were taken in the deep tow-nets. *Sagitta serratodentata* was found almost throughout the cruise with *S. maxima* and *Eukrohnia hamata* in deeper water. In very deep collections *S. planctonis, S. macrocephala* and *Eukrohnia fowleri* were taken.

Rich crustaceous plankton (Calanus, Meganyctiphanes, Themisto, etc.), was found south of Iceland, but plankton in Faxa Bay was poor.

J. H. Fraser.

The Animal Plankton in the Faroe-Shetland Section 1950.

The hydrographical results are mentioned elsewhere by Mr. F. Hermann (see the sections pp. 13—18).

The spring research (31. May—1. June) showed temperatures in the surface layers down to about 200 m. depth to be rather uniform at 7°—9° C., but about $^1/_2$° higher on the eastern side of the channel than on the western side. Hensen net hauls were rather poor, but phytoplankton components were high. In the 2-m. stramin net hauls large numbers of fish fry were caught on or near the banks, otherwise catches were normal. No eel larvae, as expected according to season and temperatures, were caught.

The late summer research (17.—19. Aug.) showed a general rise in temperature down to 200 m. with the 8° isotherm in about 200 m. depth. Surface temperatures were about $12^1/_2$°—$13^1/_2$° C. in the eastern part of the channel where great quantities of salps (especially *Salpa fusiformis*) were met with for the first time for several years; these were only in the surface layers because the temperatures were too low deeper down. Water layers deeper down than about 75—100 m. were not much warmer on the eastern than on the western side of the section. On the eastern side of the channel, along the 500-m. line, no especially strong influx of Atlantic water was met with and accordingly, eel larvae in metamorphosis stages were not present despite the fact that hauls with 2-m. stramin nets were carried out at the best time, of both the season and the day (about 2200), for catching eel larvae. Cold water was also prominent, the 6° isotherm lying even nearer the surface than during the spring research. Of animal plankton (from Hensen net and 2-m. stramin nets) only small quantities (mainly copepodid stages) were caught but, at all stations with surface temperatures over 12°C., great quantities of radiolarians were taken; these, together with the salps, indicated a rather large surface influx of Atlantic water.

Å. Vedel Tåning.

THE FISH

Eggs and Larvae.

Fish Eggs and Larvae at Faroe.

In 1950 Scottish research vessels carried out an intensive survey of Faroese waters during the following periods: 1.—19. April, 14.—22. May, 18.—27. June and 21. July—3. August. During each cruise about 40 stations covering the Faroe plateau were sampled by vertical hauls through the whole water column with a Hensen and with a 2-metre net (30 meshes to the inch). The primary purpose of this survey was to investigate the planktonic phase in the lifecycle of the haddock, but considerable data on other species were obtained at the same time.

Haddock.

The haddock spawning season at Faroe was deduced to have extended in 1950 from the last week of February to the second week of May with its peak in the second half of March and first half of April. The areas of greatest spawning intensity were north-west of Myling Head, west of Kolter and on Nolsø Bank. The spawning products were subsequently dispersed more to the southern portion of the plateau.

Faroes.

An attempt was made to estimate the total spawning effort of the Faroese haddock stock in 1950. Such an estimate is liable to various errors the magnitude of which cannot be accurately assessed on existing data, but it is believed to be of the correct order of size. The figure arrived at is 10^{13} haddock eggs for the 1950 spawning season. Growth-curves for larval haddock have been constructed. These show that growth is exponential—the increase per day in the logarithm of the length being 0.01. The chief value of this figure is in the estimation of the mortality rates at various stages of the planktonic phase. These have been very approximately estimated as follows:— 6% per day during egg stages, 16% per day hatching mortality and 6% per day during larval and post-larval life. On the basis of these rates the prospects of the 1950 haddock brood have been assessed. It is estimated that of a million newly spawned eggs twenty-three survived to assume a bottom mode of life. From what is known of subsequent mortality only five of these can be expected to survive to spawn in their turn.

Cod.

The cod spawning season in 1950 appears to have finished about a week earlier than that of the haddock. The areas of maximum spawning intensity for the two species were practically coincident although the total spawning area of the cod showed a definite tendency to extend further inshore than did that of the haddock. The total spawning assessment of the cod was slightly greater than that of the haddock although the difference cannot be considered significant in view of the magnitude of the errors to which such an estimate is subject. Growth for cod larvae was also exponential, the figure again being 0.01 per day. Mortality during the egg stage was estimated as 9% per day, during hatching 15%, and thereafter until a size of 10 mm. was attained about 6% per day. Above a size of 10 mm. cod larvae were effectively absent from the collections—whether due to a cataclysmic mortality or to some imperfection in sampling which has not been detected—is unknown.

Herring.

See Herring Committee, p. 119.

Larval saithe, *G. esmarkii* and *Ammodytes marinus* were abundant during the first cruise—the last, mostly newly hatched individuals, being concentrated in inshore waters off the north coast. *G. esmarkii* and saithe had their centre af abundance in the Nolsø and Sandø Bank area. Subsequent cruises saw successive depletions in the numbers of fish-larvae generally until a very low density was attained in July.

A. Saville.

Occurrence of 0-group Cod, Haddock and Coalfish. Summer 1950.

A survey of the pelagic stages of cod, haddock and coalfish in the Faroe area was carried out by the "Dana" in the period from 1.—20. June (Table 4 and Fig. 29). The average lengths of the cod and haddock fry were 13.8 and 12.0 mm. respectively which was quite normal for this month at Faroe. The number of pelagic cod fry (average 179 per 1-hour haul with 2-m. straming net) was about normal. The number of haddock fry (386 per 1-hour haul) indicates that the 0-group was more abundant than it usually was before the war while being not quite so strong as in 1947 and 1948 (cf. Ann. Biol. 1947 p. 28 and 1948

Figure 29. Number of larval stages of cod (above) and haddock (below). Number of specimens per 1-hour haul with 2-m. stramin-net 1.—20. June 1950.

p. 30). A calculation based on the distribution of the fry, the size and speed of the net and the numbers caught, gives the result that the minimum number of 0-group haddock in the Faroe area in the middle of June 1950 was about 3.5×10^{10}, i.e., somewhat higher than

Table 4. Larval Cod, Haddock and Coalfish.

Total catch on 20 stations[1]) over depths between 50 and 200 m. 1.-20. June 1950.

Length (mm.)	Cod	Haddock	Coalfish
5	—	3	—
5— 9	319	1171	34
10—14	1072	2767	89
15—19	502	532	36
20—24	88	72	23
25—29	27	13	5
30—34	12	5	2
35—39	1	1	—
40—45	1	—	—
Total Number	3124[2])	6753[3])	189
Number per hour	179	386	11
Average length, mm.	13.8	12.0	14.3

[1]) On all but four stations, two oblique hauls of three times 10 minutes each were made with 2-m. stramin nets; the two nets were towed for about 10 minutes at each of the depths corresponding to 100, 50, 25 and 200, 150, 125 m. of wire out respectively. On the four stations only the haul with 100, 50, 25 m. of wire was made.

[2]) Including 1102 specimens not measured.

[3]) Including 2189 specimens not measured.

would be expected from the figures given by Mr. SAVILLE, at the last International Council meeting (see Ann. Biol., this vol. p. 26). At this time of the year most of the 0-group coalfish have left the plankton.

Sixteen hauls with the eel-hand seine were carried out in 4 localities in the fjords between 9. and 12. August. The 0-group coalfish were unusually numerous, especially in the localities on the northern isles (Fuglefjord and Klaksvig), and the average total for all the hauls (901 specimens) was nearly 10 times the average total for all previous samples in Faroe fjords in August.

Very few 0-group cod were found (less than one per haul with the eel-hand seine). This may indicate a delay of the immigration into the littoral zone which normally takes place about 1. August.

E. BERTELSEN.

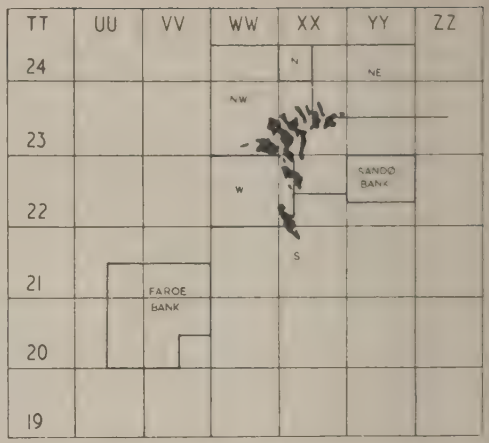


Figure 30. Subdivision of Faroe Plateau into regions.

Haddock.

An extensive survey of the haddock stocks at Faroe has been carried out each month from March to October 1950 by either "Explorer" or "Scotia", samples being taken by means of one-hour hauls with a covered otter trawl. In addition, the age and size composition of haddock landed at Aberdeen fish market by trawlers fishing at Faroe has been determined, the catches of four or five ships per month being sampled for this purpose.

Age Composition.

The age composition of haddock sampled by "Scotia" from March to October, and by "Explorer" in July and August is shown in Table 5, while the age composition of the commercial landings is demonstrated in Table 6A. The size composition of the commercial landings is shown in Table 6B and, by converting these mean lengths to weights, (using data from RUSSELL 1914[1]), and then multiplying each by the appropriate number per 10 hours fishing in Table 6A, estimates of the weights landed per 10 hours fishing have been made (Table 6 C.).

The commercial landings were composed of haddock of from one to twelve years of age amongst which the 1943, 1944, 1945, 1947 and 1948 broods were most important. The 1944 brood in its sixth year was numerically stronger than either the 1946 or 1945 broods in their fourth and fifth years respectively; the 1946 brood was very poorly represented in the catches, as it was in the North Sea. Only the largest members of the 1948 brood were landed during the early months of the year, but from June onwards when the greater proportion had exceeded the minimum landing size of 28 cm. this brood contributed a weight equal to almost half of the total weight landed. The fastest growing individuals of the 1949 brood first appeared in the fishery in October.

Extremely few individuals of the 1950 brood were taken by "Explorer" and "Scotia" between June and October (Table 5) and if these figures are representative this must be classed as a very poor brood.

Table 5. Age Composition of Haddock caught by Research Ships at Faroe-1950.

(Excluding Faroe Bank).

Nos./10 hrs. fishing

	»Scotia«				»Explorer«		»Scotia«
Year-Class	March	April	May	June	July	Aug.	Oct.
1950	—	—	—	0.1	3.1	0.5	22.8
1949	17.5	58.6	26.0	90.7	47.4	91.0	90.0
1948	142.0	54.3	25.7	54.7	24.2	107.5	22.9
1947	13.7	3.8	3.7	6.3	6.8	8.7	2.6
1946	1.0	0.6	0.5	0.5	0.7	0.5	0.3
1945	6.7	0.6	1.1	1.4	0.9	—	0.1
1944	8.3	0.8	0.7	1.0	1.4	—	1.1
No. hrs.	4	21	15	15	19	2	24

[1]) RUSSELL, 1914: Board of Agric. and Fish., Fish. Inv. Ser. II, Sea Fish. Vol. 1, pt. I.

Table 6. Aberdeen Trawlers - Market Samples - Faroe Haddock-1950.

A. Number landed/10 hrs. fishing.

Year-Class.	Feb.	March	April	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1949	—	—	—	—	—	—	—	99.3	987.91	348.7
1948	90.1	266.3	49.7	1887.3	1012.3	992.6	748.3	1230.8	719.96	788.8
1947	218.3	279.7	351.7	162.3	206.3	164.2	106.4	104.6	44.76	89.0
1946	57.7	70.4	140.0	30.8	43.1	66.3	42.6	35.3	13.80	11.0
1945	74.8	103.2	301.6	49.7	76.3	115.7	35.5	35.7	29.4	36.7
1944	79.2	150.9	310.7	60.1	55.3	59.8	147.7	62.4	42.4	52.7
1943	43.4	41.9	144.7	31.9	15.5	30.5	54.2	30.0	3.9	28.9
1942	8.9	12.6	27.1	—	4.0	12.2	11.7	1.4	2.4	2.8
1941	3.8	5.0	13.5	1.8	7.9	12.2	1.5	1.4	—	1.4
1940	3.8	4.0	18.1	5.6	1.9	—	2.5	—	—	—
1939+	2.6	3.8	9.0	—	—	—	—	—	—	—

B. Mean Lengths of each Age-Group sampled.

Year-Class.	Feb.	March	April	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1949	—	—	—	—	—	—	—	28.97	29.25	30.27
1948	33.28	29.87	31.30	31.06	33.26	35.20	36.56	36.81	39.04	38.82
1947	41.28	41.19	39.60	42.39	42.66	45.06	48.05	47.47	49.12	49.60
1946	45.39	47.54	44.06	45.43	48.51	49.23	50.08	49.07	49.70	51.81
1945	50.25	50.31	49.09	49.72	54.36	53.80	55.64	56.84	55.38	54.77
1944	56.36	55.19	53.78	56.06	59.17	57.28	58.27	59.85	57.79	58.55
1943	59.74	58.38	58.84	60.86	60.73	60.80	61.46	62.38	57.50	60.47
1942	60.87	64.67	65.17	—	68.16	63.00	65.87	61.00	64.00	66.00
1941	67.00	64.50	67.67	62.00	66.78	67.00	76.60	67.00	—	67.00
1940	67.67	69.50	77.00	70.25	68.50	—	69.00	—	—	—
1939	71.50	78.50	64.50	—	—	—	—	—	—	—

C. Estimated Weights*) landed/10 hrs. fishing (in cwts.).

Year-Class.	Feb.	March	April	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1949	—	—	—	—	—	—	—	0.40	4.69	1.57
1948	0.51	1.08	0.23	8.88	6.08	7.23	6.04	10.32	7.33	7.67
1947	2.41	2.97	3.41	2.08	2.69	2.56	2.02	1.92	0.91	1.89
1946	0.88	1.13	1.85	0.48	0.83	1.36	0.92	0.71	0.29	0.27
1945	1.59	1.98	5.52	1.01	2.09	1.47	1.07	1.15	0.89	1.07
1944	2.34	3.77	7.62	1.77	1.96	1.97	5.10	2.35	1.45	1.86
1943	1.53	1.21	4.77	1.21	0.60	1.21	2.20	1.27	0.13	1.14
1942	0.34	0.52	1.19	—	0.22	0.52	0.57	0.06	0.10	0.13
1941	0.18	0.20	0.68	0.07	0.39	0.62	0.10	0.07	—	0.07
1940	0.19	0.21	1.25	0.34	0.10	—	0.14	—	—	—
1939+	0.15	0.30	0.40	—	—	—	—	—	—	—
Total	10.12	13.37	26.92	15.84	14.96	16.94	18.16	18.25	15.79	15.67
Actual landings/ 10 hrs. by Aberdeen Trawlers.	9.65	14.05	25.73	14.83	14.26	16.41	18.44	18.04	15.15	15.48

*) from data by RUSSELL, 1914.

Size Composition.

The mean lengths and standard errors of each brood taken during each month are shown in Table 7 for each of the eight areas. The limits of these areas are shown in Figure 30. The largest fish caught were from Faroe Bank where, age for age, the fish were consistently larger than those taken anywhere on the Faroe Shelf. Around Faroe the largest fish were located in the north-west area, smaller and smaller sizes being successively encountered in the north, north-east and eastern areas, until the smallest fish of all were located on Sandø Bank. These results are in accordance with those found by PARRISH in 1947 (PARRISH 1949[1]).

[1]) PARRISH, 1949: Annales Biologiques IV (1947), pp. 30 to 31.

Table 7. Mean Lengths and Standard Errors (S.

Year-Class	Age	Month	North-West. Mean	S. E.	No. fish	North Mean	S. E.	No. fish	North-East Mean	S. E.	No. fish	East Mean	S. E.	No. fish
		June	6.0	—	1	—	—	—	—	—	—	—	—	—
		July	7.3	0.268	29	8.3	0.832	3	7.9	0.721	4	8.7	0.456	10
1950	0+	Aug.	—	—	—	—	—	—	—	—	—	10.3	—	1
		Sept.	—	—	—	—	—	—	—	—	—	10.0	0.120	144
		Oct.	13.1	0.204	50	12.0	0.186	60	—	—	—	13.0	0.721	4
		March	—	—	—	15.4	0.601	8	—	—	—	14.3	0.022	60
		April	15.9	0.150	190	16.1	0.242	18	14.0	0.222	49	14.0	0.052	726
		May	17.7	0.310	24	16.0	0.100	230	14.6	0.421	13	15.5	0.179	72
1949	1+	June	19.0	0.142	129	17.2	0.074	471	16.4	0.104	241	17.2	0.080	406
		July	21.9	0.144	154	19.9	0.175	104	19.5	0.179	99	19.1	0.099	323
		Aug.	—	—	—	—	—	—	—	—	—	20.7	0.157	128
		Oct.	25.7	0.131	185	26.4	0.145	152	25.1	0.107	277	23.5	0.445	16
		March	—	—	—	28.2	0.143	288	27.6	0.918	7	25.7	0.212	131
		April	30.5	0.112	473	29.5	0.183	177	29.0	0.155	247	26.7	0.214	129
		May	32.1	0.219	183	28.7	0.303	95	28.6	0.678	19	27.3	0.462	41
1948	2+	June	32.2	0.177	289	30.9	0.245	151	28.2	0.357	71	28.1	0.240	157
		July	33.7	0.232	136	31.4	0.675	16	30.1	0.422	41	29.3	0.152	127
		Aug.	—	—	—	—	—	—	—	—	—	31.4	0.199	185
		Oct.	35.9	0.378	51	37.8	0.330	67	34.9	0.427	40	37.0	1.909	2
		March	—	—	—	39.7	1.330	4	45.2	1.330	4	38.4	0.453	33
		April	42.0	0.665	16	—	—	—	43.5	1.330	4	38.7	0.503	28
		May	44.4	0.705	17	—	—	—	38.4	1.300	5	39.0	0.969	9
1947	3+	June	43.5	1.609	4	42.1	0.962	11	39.9	0.645	25	39.5	0.609	28
		July	43.0	1.819	3	41.7	1.819	3	42.6	0.843	14	40.7	0.336	88
		Aug.	—	—	—	—	—	—	—	—	—	45.1	1.576	4
		Oct.	48.0	1.051	9	50.6	0.941	11	43.3	1.819	3	40.0	2.229	2
		March	—	—	—	—	—	—	—	—	—	47.0	—	3
		April	51.3	—	3	—	—	—	49.0	—	1	44.0	—	2
		May	48.3	—	3	44.0	—	1	—	—	—	48.0	—	1
1946	4+	June	45.5	—	2	—	—	—	—	—	—	44.0	—	3
		July	40.0	—	1	—	—	—	48.0	—	2	48.8	—	4
		Aug.	—	—	—	—	—	—	—	—	—	53.0	—	1
		Oct.	54.0	—	2	—	—	—	—	—	—	—	—	—
		April	48.3	—	3	—	—	—	53.5	—	2	47.7	—	6
		May	52.7	—	10	—	—	—	49.0	—	5	—	—	—
1945	5+	June	51.0	—	4	52.8	—	4	—	—	—	51.7	—	3
		July	—	—	—	—	—	—	51.0	—	4	53.6	—	5
		Oct.	54.0	—	1	—	—	—	—	—	—	—	—	—
		April	56.6	—	13	—	—	—	56.0	—	1	61.7	—	3
		May	56.8	—	6	—	—	—	53.0	—	1	52.0	—	1
1944	6+	June	56.7	—	3	54.3	—	4	53.3	—	3	—	—	—
		July	58.1	—	8	—	—	—	50.3	—	3	51.5	—	4
		Oct.	57.0	—	1	60.8	—	5	60.0	—	1	66.0	—	1

The Commercial Fishery.

The average weight of haddock landed per 100 hours fishing by Aberdeen trawlers from Faroe during 1939 was 96.2 cwts., and from then on during the war there was an increase in the landings per 100 hours to a value of 240 cwts. in 1946. After this there was a decline to 156.5 cwts. in 1949 and 151.2 cwts. in 1950 (Table 8).

A comparison of the landings per 100 hours fishing in 1949/50 shows that from January to May higher values were recorded in 1949 whereas from June onwards the 1950 figures were higher. This would appear to be partly

of each Age-Group from Faroe - 1950.

Year-Class	Age	Month	West Mean	West S. E.	West No. fish	South Mean	South S. E.	South No. fish	Sandø Bank Mean	Sandø Bank S. E.	Sandø Bank No. fish	Faroe Bank Mean	Faroe Bank S. E.	Faroe Bank No. fish
		June	—	—	—	11.0	—	1	—	—	—	—	—	—
		July	—	—	—	8.3	0.435	11	—	—	—	9.5	1.020	2
1950	0+	Aug.	—	—	—	—	—	—	—	—	—	—	—	—
		Sept.	—	—	—	10.3	0.109	176	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		March	—	—	—	—	—	—	—	—	—	16.0	1.221	2
		April	14.2	0.231	69	—	—	—	14.6	0.123	121	—	—	—
		May	—	—	—	15.6	0.480	10	15.9	0.238	41	18.6	0.379	16
1949	1+	June	—	—	—	18.5	0.200	65	16.1	0.258	39	18.2	—	72
		July	—	—	—	19.8	0.120	221	—	—	—	23.5	0.107	278
		Aug.	—	—	—	—	—	—	16.7	0.242	54	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		March	—	—	—	—	—	—	—	—	—	—	—	—
		April	28.4	0.260	87	—	—	—	23.8	0.486	25	—	—	—
		May	28.8	0.790	14	—	—	—	24.6	0.507	34	38.9	1.118	7
1948	2+	June	—	—	—	32.2	0.282	114	25.2	0.482	39	—	—	—
		July	—	—	—	30.9	0.228	140	—	—	—	44.3	0.900	9
		Aug.	—	—	—	—	—	—	26.0	0.493	30	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		March	—	—	—	—	—	—	—	—	—	—	—	—
		April	41.2	0.738	13	—	—	—	38.5	1.086	6	—	—	—
		May	—	—	—	42.3	1.678	3	33.8	0.620	22	50.0	—	1
1947	3+	June	—	—	—	46.5	0.930	12	35.3	0.832	15	—	—	—
		July	—	—	—	41.5	0.596	28	—	—	—	56.0	2.229	2
		Aug.	—	—	—	—	—	—	35.1	0.788	16	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		March	—	—	—	—	—	—	—	—	—	—	—	—
		April	48.0	—	1	—	—	—	42.5	—	4	—	—	—
		May	—	—	—	49.0	—	1	40.0	—	1	66.0	—	1
1946	4+	June	—	—	—	—	—	—	42.7	—	3	—	—	—
		July	—	—	—	46.5	—	6	—	—	—	57.0	—	1
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		April	52.0	—	2	—	—	—	—	—	—	—	—	—
		May	—	—	—	—	—	—	—	—	—	63.0	—	1
1945	5+	June	—	—	—	59.3	—	6	41.7	—	4	—	—	—
		July	—	—	—	49.3	—	3	—	—	—	62.8	—	5
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—
		April	—	—	—	—	—	—	—	—	—	—	—	—
		May	—	—	—	55.0	—	3	50.0	—	1	—	—	—
1944	6+	June	—	—	—	58.0	—	3	43.0	—	2	—	—	—
		July	—	—	—	51.4	—	9	—	—	—	—	—	—
		Oct.	—	—	—	—	—	—	—	—	—	—	—	—

due to the great influx of the 1948 brood into the fishery from June onwards, 1950 (Tables 5A and C), leading to an increase in the weights of "small" fish landed per 100 hours fishing (Table 8), and partly due to an increase in the extra large plus large categories during the later part of the year.

During 1950, the total hours fishing exceeded that in 1949, as did also the total weights of haddock landed.

R. Jones.

Table 8. Landings of three Size Categories of Haddock by Aberdeen Trawlers from Faroe 1949 and 1950.

Weight landed/100 hrs. fishing (cwts.).

	Hrs. fishing 1949	Hrs. fishing 1950	XL + L 1949	XL + L 1950	Medium 1949	Medium 1950	Small 1949	Small 1950	Total 1949	Total 1950
Jan.....	345	4672	—	—	136.4	55.0	24.8	23.2	161.2	78.2
Feb.....	4545	7131	5.5	4.0	118.8	72.6	21.4	19.9	145.7	96.5
March....	8443	11488	0.3	1.0	197.9	123.9	12.1	15.6	210.3	140.5
April.....	5757	6952	37.6	15.4	360.8	210.3	25.4	31.6	423.7	257.3
May.....	1459	5650	50.2	1.2	180.8	59.2	15.1	51.5	246.1	111.9
June.....	15760	16602	18.3	15.8	66.6	45.6	37.6	86.9	122.6	148.3
July.....	13102	10759	8.3	29.9	46.5	38.4	28.1	74.3	82.9	142.6
Aug.....	4608	6494	64.0	18.0	58.9	68.7	20.4	77.4	143.3	164.1
Sept.....	1425	6207	21.8	61.5	45.6	33.7	17.0	89.2	84.3	184.4
Oct.....	1209	5182	12.2	55.2	79.6	44.1	43.0	81.1	136.8	180.4
Nov.....	4584	7658	12.6	70.0	78.3	50.5	49.2	31.0	140.1	151.5
Dec.....	8283	8244	19.0	66.9	70.7	52.0	28.6	35.9	118.2	154.8
Total.....	69520	97039								
Annual Means.....			18.3	26.9	109.8	53.6	70.7	53.6	156.5	151.2
Total Weight landed (cwts.) .			12,728	26,108	76,341	68,636	19,704	51,941	108,772	146,685

XL = Extra large L = large

Lemon Sole.

During 1950 the landings of lemon soles at Aberdeen by British fishing vessels from Faroe totalled 18,950 cwt. This represents an increase of 3,904 cwt. over the corresponding total for 1949. The increase was achieved by a big increase in fishing power in which the number of trips rose by 45% and the number of hours fishing by 40% over the 1949 totals. The catch per 100 hours fishing for the year was 19.5 cwt. revealing a further decline from the record of 33 cwt. in 1946. The maintenance of the high, though decreasing, average annual catch per unit of fishing power from 1945 to the end of 1949 has been attributed to the total British fishing power at Faroe during these years being considerably less than half that of the average for the period 1930—1938. The consequences of the sudden increase in trawling effort in 1950 will, therefore, be watched with great interest.

In 1950 one or other of the Scottish research vessels operated round the Faroes steadily from early in March until mid-October. During this time 877 lemon soles were caught by otter trawl—531 in 65½ hours fishing with a small 30-foot trawl and 346 in 29 hours fishing with a 48-foot trawl. The size frequencies and age composition of these fish (only 14 of which were taken in the small-mesh covering the cod-end) is given in Table 9.

Table 9.

Size Frequencies.

5 cm. group	< 26	26-30	31-35	36-40	41-45	46-50	Total
No. of fish	163	233	281	160	37	3	877
%.....	18.6	26.6	32.0	18.3	4.2	0.3	100

Age Composition.

Brood	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940
Number	1	12	82	315	23	54	131	21	93	18
%.....	0.1	1.4	9.4	35.9	2.6	6.2	14.9	2.4	10.6	2.0

Age Composition.

Brood	1939	1938	1937	1936	—	—	—	1932	Total
Number	77	16	29	4	—	—	—	1	877
%.....	8.8	1.8	3.3	0.5	—	—	—	0.1	100

Most of the fish taken were thus of small or medium size. The age analysis reveals the 1946 brood (IV-group) as the outstanding contributor numerically to the stock in 1950. Three older broods, 1943, 1941 and 1939, supplied the bulk of the larger fish which according to market records were still in plentiful supply. Recruitment in 1944 and 1945, however, was extremely poor so that the 1946 brood at present is the mainstay of the small category and must be expected to be heavily fished during the next few years in its passage through the medium and large categories.

B. B. Rae.

alibut.

able 10. Size and Age of Halibut caught at Faroe by Scottish Research Vessels in 1950.

onth	Area	No. of fish	Length in cm., with Age-Group (in Brackets)
	XX 24	2	30 (II), 31 (II).
arch	YY 23	2	26 (II), 46 (III).
	XX 23	5	45 (III), 48 (III), 53 (IV), 55 (IV), 56 (IV)
	WW23	5	32 (II), 33 (II), 46 (III), 48 (III), 48 (III).
	WW22	4	31 (II), 32 (II), 34 (II), 54 (IV).
	WW24	1	58 (IV).
pril	ZZ 23	1	62 (IV).
	XX 22	1	32 (II).
	XX 23	3	29 (II), 50 (III), 50 (III).
	XX 24	3	12 (I), 30 (II), 50 (III).
	WW23	1	33 (II).
ay	XX 23	1	60 (IV).
	VV 23	1	45 (III).
ne	XX 24	7	29, 32, 33, 33, 34, 35, 40 (all II).
	XX 20	1	69 (V).
	XX 21	1	51 (III).
	WW21	3	58 (IV), 62 (IV), 73 (V).
	WW22	1	36 (II).
ly	WW24	1	37 (II).
	XX 23	6	20 (I), 20 (I), 35 (II), 36 (II), 39 (II), 44 (III).
	YY 23	1	73 (V).
	XX 24	2	36 (II), 36 (II).
ept.	WW22	1	48 (III).

Throughout the year 1950 the Scottish research vessels "Explorer" and "Scotia" captured 6 halibut in Faroese waters. Table 10 gives ne statistical squares, and the months in which aptures were made, together with the size and ge of the fish. Nine-tenths of the catch consisted of two, three, and four-year-old fish. roup II was dominant, forming half of the otal. With one exception the older fish (group V and over) occurred in water of over 100 netres. Examination of market samples indicates that in the catches of commercial trawlers also the dominant age-groups are II and II.

A. D. McIntyre.

od. Iceland.

Short Survey of the Icelandic Stock of Cod during the Years 1928-1950.

At the initiative of Prof. Johs. Schmidt, continuous investigations of commercial landings f the Icelandic stock of cod were begun in 928. During the years 1925—27, Dr. Bjarni æmundsson had already collected representative samples of otoliths from the spawning grounds off the south-west coast from January to May.

We are thus in possession of otolith samples from 1925 onwards and of length measurements of the commercial catches from the principal fishing grounds from 1928 onwards. Most of the material relates to long-line caught fish. Otoliths have also been collected from fish caught by nets, Danish-seine and trawl. Finally, otoliths have been collected aboard Icelandic and foreign research vessels. The otolith material now totals about 100,000.

The results from the years 1928-1930 have been published by Dr. Å. V. Tåning (1931).

In 1931 the cod investigations were taken over by Fiskifélag Islands (The Icelandic Fisheries Association) and were carried out by Mr. Arni Fridriksson, who published his yearly report in the publications of Fiskifélag Islands (1931—1937). Since 1947 the present author has been in charge of these investigations.

On account of recent advances in the technique of otolith reading it was considered necessary to revise all the material. This revealed some differences between my readings and those of Dr. Tåning and Mr. Fridriksson. The new readings also included determinations of the so-called spawning zones in the otoliths which have given most valuable information as to the recruitment of the stock. All these readings have been performed by Mr. Ingimar Oskarsson.

Fig. 31 A shows the age-distributions of the spawning cod in the years 1928—1950 based on ca. 25,000 determinations. The number of determinations varies somewhat from year to year. The fish were caught on long-lines (except in 1928 and part of 1942) off the south and south-west coast during January to May.

The most striking feature of the figure is the great fluctuations in the strength of different year-classes. The 1922 year-class, appearing on the spawning grounds in 1930 as 8-year-old fish, has proved to be of paramount strength. Since then 17 year-classes (1920—36) have constituted the Icelandic catches, and of these the 1922 year-class alone, as 8—13-year-old fish, has supplied 26%. It is known that a great part of this year-class grew up in Greenland waters, as is shown both by the marking experiments and by its low average length. The 1924 year-class first appeared on the spawning grounds in 1932. It is the second strongest year-class in the stock. The 1922 and 1924

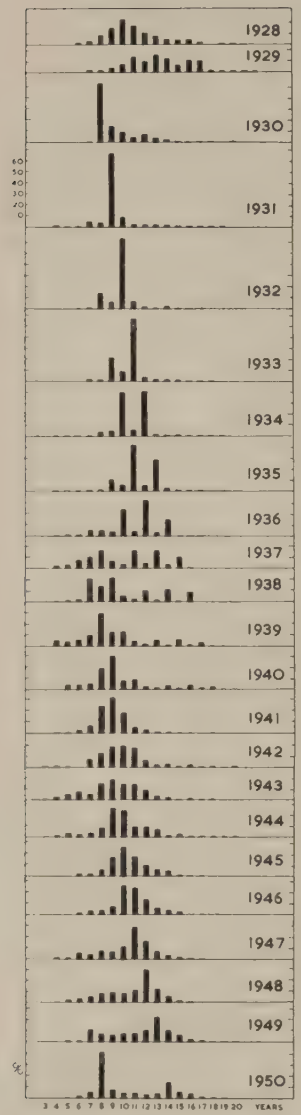


Figure 31 A.

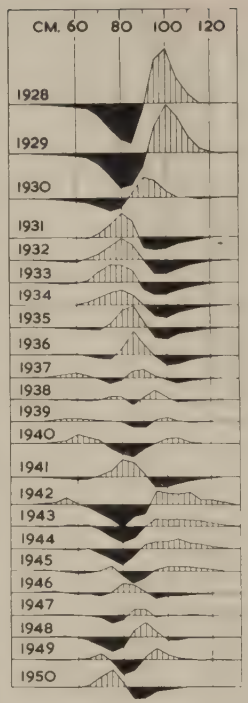


Figure 31 B.

Figure 31. A. Age distribution of the Icelandic stock of cod during the winter seasons 1928—1950, from the south and south-west coasts. Long-line caught fish.

Figure 31. B. Deviations from the average length of the Icelandic stock of cod during the winter seasons 1928—1950. Long-line caught cod from the south and south-west coasts.

year-classes together supplied about 72% of the total Icelandic catch of cod during the period 1930 to 1937. From 1937 to 1943 the 1931, 32, 33 and 34 year-classes predominated. Between 1944 and 1949 the cod fisheries were largely based upon the 1935 and 1936 year-classes which constituted about 42% of the total catch. Finally, in 1949, the 1942 year-class appeared and, constituting 41% of the total, dominated the 1950 catches. This year-class will presumably be of still greater importance in 1951.

Fig. 31 B shows the year by year deviations from the average length of long-line caught cod off the south and south-west coast from January to May during the above-mentioned period 1928—1950. As was to be expected, it shows, in general, the same trends as Figure 31 A.

JÓN JÓNSSON.

Haddock.

Notes on the Food of Haddock (*Gadus aeglefinus* L.) at Iceland.

During the spring of 1950 the authors made some investigations on the location and extent of herring spawning grounds off the S. and SW. coasts of Iceland[1]). One of the methods used was to locate the distribution of "spawny haddock". As there were often only traces or very small quantities of herring spawn in the stomachs, it became necessary to collect the stomachs for examination as opposed to limiting observations to the cases where the external appearance of the haddock would indicate the fish as "spawny"[2]). As will be seen from Table 11, the material has been collected

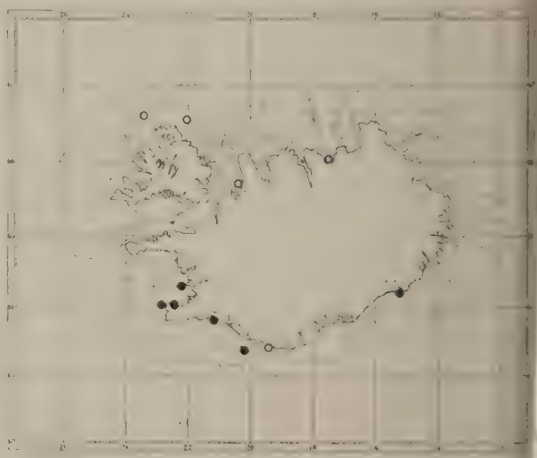


Figure 32. Map of Iceland giving the localities where haddock stomach samples were collected by the author (black) and H. THOMPSON (white).

[1]) A. FRIDRIKSSON and G. TIMMERMANN: Herring Spawning Grounds off the South Coast of Iceland during Spring 1950. Journ. du Cons., XVII, 2, pp. 172—180, Copenhague 1951.

[2]) ALEXANDER BOWMAN: The Occurrence of "Spawny" Haddock and the Locus and Extent of Herring Spawning Grounds. Fish. Board Scotland, Sci. Invest. 1922, 4, 1923.

Table 11. Food Analyses of Icelandic Haddock, March-May 1950.

Species of Food found	Hornafjord (18.IV—27.V) No. of posit. Stom.	%	Westm. Isles (27.III—21.V) No. of posit. Stom.	%	Eyrarbakki (3.—28.IV) No. of posit. Stom.	%	Sandgerdi (5.—26.IV) No. of posit. Stom.	%	Keflavik (3. IV) No. of posit. Stom.	%	Akranes (30.III—3.IV) No. of posit. Stom.	%
(Bait)	(36)	(13)	(8)	(1)	(2)	(2)	(49)	(23)	(18)	(10)	(7)	(5)
1. Sand-eels	—	—	350	36	—	—	—	—	—	—	1	1
2. Remains of (other) young Fish	—	—	115	12	18	14	—	—	14	8	46	33
3. Herring Spawn	—	—	116	12	+	+	—	—	—	—	—	—
4. Sea-Brittles	31	11	138	14	36	28	26	12	110	61	44	31
5. Sea-Urchins	30	11	118	12	28	22	20	10	89	50	36	26
6. Snails	4	1	14	1	4	3	3	1	7	4	9	6
7. Mussels	10	4	216	24	84	65	8	4	41	23	12	9
8. Squids	—	—	9	1	—	—	—	—	—	—	—	—
9. Decapoda macrura (Nephrops incl.)	2	1	78	8	20	15	12	6	36	20	30	21
10. Other Decapods	2	1	82	9	7	5	—	—	1	1	—	—
11. Hermit-Crabs	5	2	5	1	—	—	1	1	9	5	8	6
12. Isopods	—	—	2	+	—	—	—	—	3	2	—	—
13. Amphipods	—	—	—	—	—	—	—	—	1	1	1	1
14. Schizopods	16	6	—	—	—	—	—	—	—	—	—	—
15. Worms	3	1	207	22	48	37	1	+	3	2	1	1
16. Pantopods	1	+	—	—	—	—	—	—	—	—	—	—
Tot. No. of Stom. inv.	270		960		130		210		180		140	

In almost every major fishing village from Hornafjord (SE.) to Akranes (Faxe Bay) during the period 27. March to 21. May.

Although the number of empty stomachs is not listed in the table, it will be seen that it was quite considerable. It must also be noted that, in cases where herring spawn was present in appreciable quantity, the stomachs contained hardly any other food at all. The total number of stomachs examined amounted to 1,890, with the following representation of the different fishing centres:

Hornafjord	270	Sandgerdi	210
Westman Islands	960	Keflavik	180
Eyrarbakki	130	Akranes	140
Total	1,360	Total	530

All the haddocks examined in Hornafjord, Sandgerdi, Keflavik and Akranes had been caught on long-line while the majority of the catches from the Westman Islands and Eyrarbakki were made by trawl and Danish seine. This fact explains the relatively large number of stomachs containing "bait" (frozen herring) from the four first-named localities.

These preliminary investigations on the subject are qualitative only, but the relative importance of the different components can be seen from the table where some details are given. There are rather pronounced differences in the composition of the food from place to place. At the Westman Islands various species of fishes, especially the sand-eels (Ammodytes), are the most important food. Also at the Westman Islands and at Eyrarbakki, worms, especially polychaets, are found in considerable quantities, as compared with all other grounds where this kind of food occurs sparsely or not at all at this time of the year. Another interesting feature is the relative predominance of schizopods (euphausids) in the Hornafjord-area. A number of stomachs were found stuffed full with this food. In all areas along the coast echinoderms seemed to be of considerable importance as a common food item. Not only were brittle-stars found in numbers, as for instance in the southern part of the Barents Sea[3]), but sea-urchins also occurred almost as frequently. Finally the three main groups of molluscs played an important rôle, especially the mussels which, in some places, were found

[3]) D. Wilke: Der Mageninhalt von Schellfischen aus dem Barentsmeer. Ber. Deutsch. Wiss. Komm. Meeresforschung, N. F., Bd. 9, H. 4, 1939.

in very great quantities: this was particularly the case with the species *Psammobia tellinella*.

In his paper on the biology of the Icelandic haddock, THOMPSON[4]) gives a survey of the food of this fish. The material is limited to five samples comprising 110 stomachs, collected in June, mostly off the north coast. Sand-eels were only found in one sample—the single one taken in the south (Portland). They occurred there as the only food and in large quantity. In the other four samples the following species of food predominated: 1) in Skjálfandi Bay, schizopods (100%), 2) at Skagaströnd, brittle-stars (over 90%), 3) E. of North Cape, brittle-stars (93%) and 4) W. of North Cape, polychaets (83%).

[4]) HAROLD THOMPSON: General Features in the Biology of the Haddock (*Gadus aeglefinus L.*) in Icelandic Waters in the Period 1903–1926. Rapp. et Proc. Verb. Vol. LVII, 1929.

A. FRIDRIKSSON and G. TIMMERMANN.

Plaice.

Two 1-hour trawl samples of plaice from Faxa Bay (International Standard Stations, territorial and extra-territorial waters) were obtained by the Scottish research vessel "Scotia" in September. Quantitatively the ratio of territorial to extra-territorial was about 3:1, highest frequencies occurring in the 5-cm. range 26—30 cm. in the former and 29—34 cm. in the latter zone. Comparatively few plaice were under 25 cm.; full size ranges were 17—44 cm. and 20—41 cm. respectively. Seven year-classes, 1942—48, age-groups VIII—II, were represented on the grounds, the strongest being the 1945 brood (Gr. V) — 43% and 40% respectively—followed by 1947—46 within, and 1944—43 outwith territorial waters. The size-ranges of the individual broods showed considerable overlapping, resulting in extremely small differences in the means though, in general, these were significantly higher, and indicated faster growth, on extra-territorial grounds. More detailed particulars of the age-composition of the samples are given in Table 12.

In nine hauls between Reykjanes and Portland, 37 plaice, mostly age-groups V and IV, were caught in seven hours fishing time.

B. B. RAE. J. M. LAMONT.

Table 12. Age Composition of Plaice Samples.

Territorial: International Standard Station 64 03′ N. 22°33′ W. FF27 C. 27—37 metres.

Age-Group	II	III	IV	V	VI	VII	VIII
Year-Class	1948	1947	1946	1945	1944	1943	1942
No. (p. hr.)	18	74	54	127	18	7	1=299
%.....	6.0	24.8	18.1	42.5	6.0	2.3	0.3
Range (cm.)	18/30	17/33	19/33	23/34	25/35	29/35	—
Mean (cm.)	26.6	26.2	26.8	27.9	28.6	31.9	44.0

Extra-territorial: International Standard Station 64 08′ N. 22 22′ W. FF27 d. 33 metres.

No. (p. hr.)	3	13	12	45	22	14	4=113
%.....	2.7	11.5	10.6	39.8	19.5	12.4	3.5
Range (cm.)	22/30	20/30	26/35	27/37	25/40	31/41	31/38
Mean (cm.)	25.3	25.1	31.1	31.6	32.5	34.1	35.7

Combined.

No. (p. hr.)	10.5	43.5	33	86	20	10.5	2.5=206
%.....	5.1	21.1	16.0	41.8	9.7	5.1	1.2
Range (cm.)	18/30	17/33	19/35	23/37	25/40	29/41	31/44
Mean (cm.)	26.4	26.1	27.6	28.8	30.7	33.3	37.4

Lemon Sole.

Using a small 30 foot trawl in September, 1950, the "Scotia", in one hour's fishing, caught 52 lemon soles at the standard territorial position in the southern half of Faxa Bay and 41 at the standard extra-territorial position. Fifty-four of the 93 fish were less than 30 cm. in length. The age composition of the catches together with 29 fish taken in 7 hours' fishing along the south coast of Iceland has been determined as in Table 13.

From these results the following observations may be noted:—

(a) the superior strength of the 1946 brood, especially at the inshore station, and to a less degree of the 1943 and 1941 broods (as in Faroese waters.).

(b) the complete absence, from these samples, of the three broods 1945, 1944 and 1942 from Faxa Bay; the preponderance of certain broods and the poverty or absence of others in this region has been observed in earlier years and appears to indicate that in Faxa Bay the numerical ratio of good to poor broods may be greater than has been calculated for other regions in the northern Atlantic.

(c) the presence of the oldest fish (XI-group and over) at the extraterritorial station of Faxa Bay.

Table 13. Age Composition of Lemon Sole in Faxa Bay.

Brood	Territorial 64°03′ N.- 22°33′ W. No. of fish	Extra-territorial 64°08′ N.- 22°22′ W. No. of fish	South Coast Reykjanes-Portland No. of fish	Totals	%
1948	1	—	—	1	0.8
1947	2	—	—	2	1.6
1946	31	17	7	55	45.1
1945	—	—	—	—	—
1944	—	—	2	2	1.6
1943	7	4	6	17	13.9
1942	—	—	4	4	3.3
1941	10	12	6	28	23.0
1940	1	1	1	3	2.5
1939	—	2	2	4	3.3
1938	—	1	1	2	1.6
1937	—	3	—	3	2.5
1936	—	1	—	1	0.8
Totals	52	41	29	122	100.0

(d) the maturities: 34 of the 55 fish of the 1946 brood were males 3 of which were immature and 31 spawning or spent: of the 21 females 18 were immature and 3 spawning or spent: the few younger fish were immature and the older individuals, with the exception of two seven-year-old females which were at maturity stage II, were all spawning or spent.

B. B. Rae.

Halibut.

F.R.S. "Scotia" captured halibut at three Icelandic stations in September, 1950. Two of the positions were in Faxa Bay, one inside the three mile limit and one outside; both were international stations used by previous investigators. The sizes and age-groups of the halibut caught are given in Table 14. A total of 44 fish were taken of which three quarters belonged to age-group I, and were caught mostly at the inner station.

Data on the length composition of halibut stocks at Iceland were collected by an observer on an Aberdeen commercial line fishing vessel in August, 1950, (Table 15). Similar data, collected from the same grounds in August, 1949, are included for comparison, and indicate that in this area at least there has been no obvious change in length between 1949 and 1950. The distinct difference between the lengths of fish caught at the south-east Iceland position and those from west Iceland is probably accounted for partly by the fact that the former grounds were considerably more shallow, approximately 100 fathoms, while the latter were mostly over 200 fathoms.

Table 14. Size and Age of Halibut caught by Scottish Research Vessels.

64°03′N. 22°33′W. 1950, 18. Sept. Depth: 32 m.			64°08′N. 22°22′W. 18. September 33 m.			63°52′N. 22°58′W. 19. September 115 m.		
Size	No. of fish	Age-Group	Size	No. of fish	Age-Group	Size	No. of fish	Age-Group
16	3	I	16	1	I	19	1	I
17	9	I	20	1	I	45	1	II
18	5	I	41	1	II	68	1	V
19	4	I	43	1	II	72	1	VI
20	4	I	50	1	III			
21	4	I	73	1	V			
22	1	I						
40	2	II						
41	1	II						
47	1	II						

Total number of fish: 34, 6 and 4.

Table 15. Size Distribution of Halibut caught by an Aberdeen line vessel at Iceland in 1949, 1950.

Size Range in cm.	W. Iceland, 1949 Area DD 26 Depth 200—220 fath.		W. Iceland, 1950. Area DD 26 Depth 200—220 fath.		S. E. Iceland, 1950. Area QQ 27 Depth 120 fath.	
	Number	%	Number	%	Number	%
55— 59	—	—	—	—	1	3
60— 64	—	—	—	—	—	—
65— 69	—	—	—	—	1	3
70— 74	—	—	—	—	5	16
75— 79	—	—	—	—	5	16
80— 84	—	—	—	—	5	16
85— 89	—	—	—	—	4	13
90— 94	—	—	—	—	3	10
95— 99	2	2	—	—	4	13
100—104	4	4	—	—	1	3
105—109	2	2	6	3	—	
110—114	16	15	10	5	—	
115—119	13	12	24	12	—	—
120—124	13	12	20	10	—	—
125—129	12	11	24	12	—	—
130—134	8	7	22	11	1	3
135—139	13	12	27	13	—	—
140—144	9	8	27	13	—	—
145—149	6	6	20	10	—	—
150—154	3	3	10	5	1	3
155—159	4	4	4	2	—	
160—164	—	—	4	2	—	
165—169	—	—	3	3	—	—
170—174	1	1	2	1	—	—
175—179	1	1	1	0.5	—	
Totals	107	—	204	—	31	—

A. D. McIntyre.

Exotic Fishes. **Greenland.**

Two specimens of rare fishes have recently been landed by Aberdeen fishing vessels from the N. W. area:—

1. *Astronesthes gemmifer* GOODE and BEAN, caught on a great line 15′ S. W. from the Westmann Isles in 250 fathoms on 27.9.49.
2. *Himantolophus reinhardti* LÜTKEN, caught by steam trawler 10′ S. E. from Westmann Isles in April, 1950.

The identification of both fishes has been confirmed by Mr. N. B. MARSHALL of the staff of the British Museum (Natural History), London, where the specimens now remain.

B. B. RAE.

Eggs and Larvae.

Fish-fry in West Greenland Waters, July 1950.

During the period 1. to 23. July the "Dana" (III) operated in West Greenland waters. The main objects were: 1) to make a general review of the hydrography over the West Greenland Banks and in the deep water westwards to the pack-ice in the Davis Strait, and 2) to study further the distribution of the important fish larvae on the banks and in the deep water in the Davis Strait and northwards to the southern part of Baffin Bay (off Disko). It was of special interest to compare the situation with that found 25 years earlier by Prof. AD. S. JENSEN, during his cruise in 1925 with

Figure 33. Distribution of Cod fry. 1.—23. July 1950. Nos. per ½-hour hauls. 100 and 200 metres oblique hauls.

Figure 34. Occurrence of Halibut larvae 1950. Cf. text to Fig. 33, size in mm. in brackets.

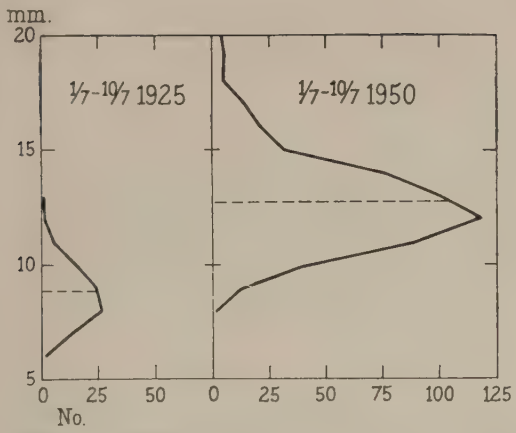


Figure 35. Size of Cod fry in the same area and at the same season, 1925 and 1950 respectively.
1925 average size 8.8 mm., 3.8 spec. per hour.
1950 average size 12.8 mm., 41.3 spec. per hour.

"Dana" (II) to the same waters (see Rapp. et Proc. Verb. Vol. 99, 1926, p. 85 et seq.). The same implements were used in 1950 as in 1925, viz., for the catch of fish larvae, the 2-m. stramin net. The hauls in 1950 were oblique hauls of 30 min. duration with 100 and 200 metres of wire out; some other scattered hauls were operated in deep water. We will here only consider the 100 and 200-m. hauls and only the catches of fry of cod, halibut, Greenland halibut and redfish.

Cod.

Larval cod were found over the whole area from the stations scattered south-west of Cape Farewell to about 67°30′ N. Lat., predominantly on Fylla Bank, Lille Hellefiske Bank and the southern part of Store Hellefiske Bank,

Figure 36. Distribution of Greenland Halibut fry 1950.
Cf. text to Fig. 33.

Figure 37. Distribution of Redfish fry 1950.
Cf. text to Fig. 33.

i.e., in the warmer water off the West Greenland coasts northwards to about the Holsteinborg—Cape Walsingham ridge (see chart Fig. 33). The northern catches were probably of larvae which had drifted to those localities from spawning places on the southern part of Store Hellefiske Bank and farther to the south (cf. Paul M. Hansen, Rapp. et Proc. Verb., Vol. 123, p. 17 et seq.). The southern catches (in the northern part of the Labrador Sea) are of special interest, because these cod larvae were probably carried there by the Irminger current from the east coast of South Greenland where previous investigations have revealed scattered occurrences of cod larvae originating from spawnings either along the western border of the narrow East Greenland ridge or off West Iceland. (cf. Ann. Biol. I, 1943, p. 96 and later records of the "Dana" *inter alia* off Tingmiarmiut on the east coast.) It is not likely that they were from spawnings on the banks off Julianehåb because in that case they would have had to cross the East Greenland Arctic current. The size of these cod-larvae was 11—21 mm. about 2.—4. July, and 24—34 mm. about 22.—23. July. The distribution of cod larvae in the Davis Strait was rather similar to that found by Ad. S. Jensen 1925 (*l.c.* chart Fig. 54, p. 88)[1]).

Fig. 35 shows a comparison of size and number of cod larvae caught at exactly the same season and in the same area (between ca. 63° N. Lat. and 67° N. Lat.) in 1925 and 1950. The cod larvae were much bigger in 1950 than in 1925, and about ten times as many were caught per haul in 1950 as in 1925; this was probably due to the higher temperatures in 1950 than in 1925 when the temperatures on the banks were below normal (see the hydrographical section of this report from North-Western Area pp. 21 et seq.).

[1]) Fry of the Polar cod (*Gadus saïda*) was not found during the cruise 1950, contrary to 1925, when great quantities were found by the "Dana" in the northern part of the area (see pp. 88 and 94 in Jensen 1925).

Halibut.

Chart Fig. 34 shows records of the few halibut larvae caught in 1950; the sizes of these were 15—27 mm. The southern records were probably, like those of the cod, of larvae carried to those localities from East Greenland by the Irminger current. Ad. S. Jensen had 2 records of halibut larvae in 1925 (cf. *l.c.* chart Fig. 55 p. 95).

Greenland Halibut.

Chart Fig. 36 shows the many records of the Greenland Halibut larvae, the distribution of which was very similar to that found by Ad. S. Jensen 1925 (cf. *l.c.* chart Fig. 55 p. 95). Probably the position of the southern records of this species is to be explained in the same way as the records in those positions of the preceding two species; the species is, however, known to spawn in the deep water of the Davis Strait (Ad. S. Jensen). The size of the fry was 18—53 mm.

Redfish (*Sebastes marinus*).

This species spawns in great quantities both in the Denmark Strait and in the Labrador Sea (cf. for instance Ad. S. Jensen, Vidensk. Medd., Bd. 74, 1922, p. 92 et seq. and Tåning, Journ. du Cons., Vol. 16, 1949, p. 91 et seq.); a very few spawn in the Davis Strait proper and in some Greenland fjords where spawning has been recorded only in the present warm period (from 1924 onwards, by Tåning and Paul M. Hansen). The chart Fig. 37 shows the records for 1950 which confirm the previous findings of Paul M. Hansen, Ad. S. Jensen and Tåning. The size of the larvae caught in the Labrador Sea and the Davis Strait on stations recorded in the chart was 8—14 mm. at the beginning of July and 9—20 mm. 22.—23. July.

Å. Vedel Tåning.

Comité Atlantique.

Sous-Comités { **Plateau Continental Européen,**
Plateau Continental Africain,
Méditerranée Occidentale.

INTRODUCTION

Les auteurs suivants ont apporté leur contribution à la préparation de ce rapport.

A. Les Conditions de Milieu.

JEAN FURNESTIN (Maroc) — Résultats des observations faites en 1949, en continuation de celles régulièrement entreprises depuis 1948. La présence d'eaux exceptionellement chaudes sur les côtes du Maroc a eu des conséquences marquées sur la répartition des poissons (*Thynnus thynnus* LIN.), (*Germo alalunga* GMELIN).

V. F. C. VELEY (Angleterre) — L'auteur expose comment il lui paraît possible de prédire l'avenir de la pêche du merlu par les conditions de température de l'eau pendant la première année d'existenee de ce poisson et celles des vents pendant la période de ponte.

MARIE-LOUISE FAURE (Maroc) — Déplacement saisonnier de différentes espèces planctoniques en relation avec le cycle hydrologique dans la région.

B. Les Poissons.

I. Gadidés.

Le Merlu (*Merlucius merluccius* L.)

R. LETACONNOUX (France) — Etudiant la répartition du stock de merlus débarqués à La Rochelle et montrant la stabilisation de l'exploitation à un faible niveau.

II. Clupéidés.

Ces rapports sur la biométrie et la biologie des Clupéidés (hareng excepté) donnent les résultats des observations faites en 1950 en application des décisions prises à la Conférence de Biarritz en 1948, en suivant les techniques internationales établies au cours de cette conférence. Ils font suite aux rapports précédents déjà publiés dans les *Annales Biologiques*.

La Sardine (*Clupea* = *Sardina pilchardus* WALB.)

JEAN LE GALL et ses Collaborateurs France
R. FERNANDEZ et F. NAVARRO ..... Espagne
M. OLIVER et F. NAVARRO..... Espagne
B. ANDREU, J. RODRIGUEZ-RODA et M. G. LARRANET ..... Espagne
J. FURNESTIN et M.-L. FAURE..... Maroc

La Sardinelle (*Sardinella aurita* L.)

M. OLIVER et F. NAVARRO..... Espagne

III. Scombridés.

Le Maquereau (*Scomber scombrus* L.)

JEAN LE GALL et ses Collaborateurs. France

IV. Thonidés.

En application des résolutions des Conférences de Malaga et de Tunis 1949.

Le Germon (*Germo alalunga* GMELIN.)

ROBERT LETACONNOUX..... France
HENRI HELDT ..... Tunisie
JEAN LE GALL et ses Collaborateurs. France

La Bonite à Ventre Rayé (*Katsuwonus pelamys* L.)

JEAN LE GALL..... France

JEAN LE GALL.

LES CONDITIONS DE MILIEU

Hydrologie.

Hydrologie des Côtes Marocaines (Température). Année 1949.

Les résultats ci-dessous exposés font suite aux comptes-rendus des travaux exécutés en 1947 et 1948.

Ils ont été obtenus à partir d'opérations faites au cours des mois de Février, Mai, Août et Novembre, le long de 16 lignes perpendiculaires à la côte marocaine, entre Tanger et le Détroit Canarien.

La carte des isothermes rend compte de la situation hydrologique de l'année 1949 qui peut être résumée comme suit:

1. Les observations de 1949 permettent de vérifier l'existence des mêmes phénomènes périodiques qu'en 1947 et 48.

(a) Après une période d'équilibre hivernal l'hydrologie de la zone marocaine évolue d'abord de manière peu marquée au printemps, puis brusquement et avec force en été.

(b) Cette évolution s'est manifestée d'abord dans le secteur sud par un certain refroidissement, en profondeur, de la zone côtière, suivi d'un réchauffement net au printemps.

(c) Elle s'est ensuite développée de manière brusque et rapide vers le nord où des masses d'eaux chaudes provenant du large (sud-ouest) ont envahi la grande baie ibéro-marocaine en même temps que les eaux froides issues de la profondeur (eaux de pente) avançaient vers le rivage et recouvraient le Plateau Continental.

(d) Puis, en automne, un mouvement inverse s'est amorcé qui a fait reculer les eaux superficielles chaudes vers le sud-ouest et les eaux froides du Plateau vers la profondeur, les unes et les autres tendant vers leur position d'équilibre qu'elles ont retrouvée en hiver.

2. Ces observations ont, en outre, permis de constater que l'année 1949, du point de vue hydrologique, a été nettement plus chaude que les deux années précédentes.

En effet depuis que nous procédons à des observations périodiques les températures de 24° et 25° rencontrées en Août dans le secteur côtier n'avaient pas encore été relevées.

Ces hautes températures affectaient non seulement la surface mais aussi les profondeurs intermédiaires de la zone côtière et il en

Figure 1.

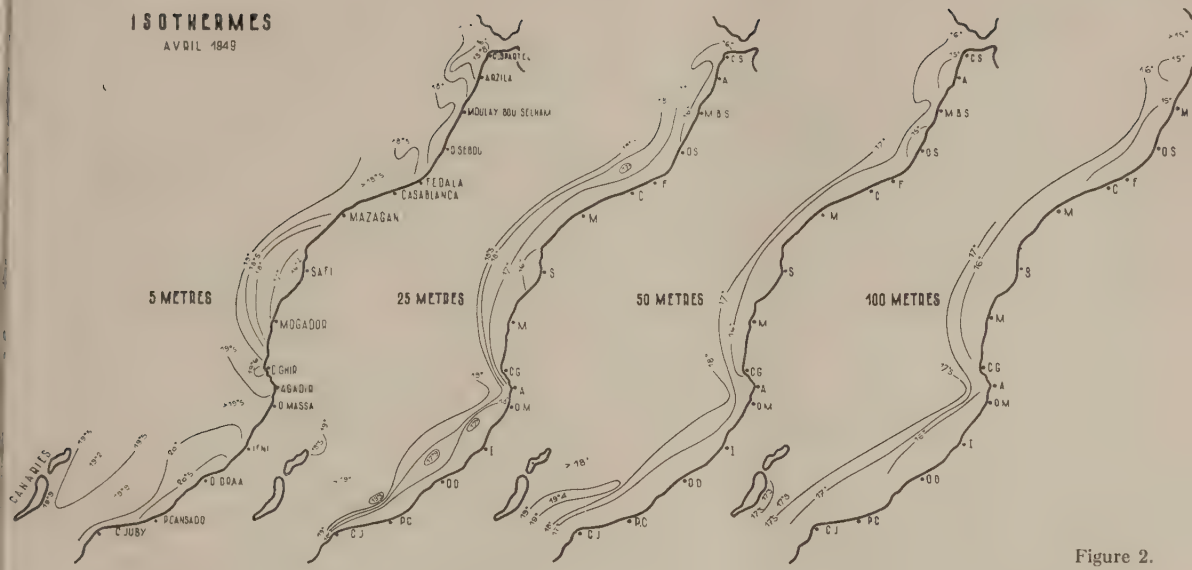


Figure 2.

est résulté un épanouissement nettement moins important des eaux profondes froides au voisinage des côtes.

3. En dehors des traits généraux de cette hydrologie périodiquement renouvelée, des différences locales apparaissent d'une année à l'autre.

Peu importantes, sinon insignifiantes pour l'ensemble du système océanique, ces variations ont des conséquences marquées sur la répartition des espèces ichthyologiques exploitées par la flottille marocaine de pêche et donc sur la pêche elle-même.

C'est en effet à la présence d'eaux exceptionnellement chaudes dans le secteur nord que doit être attribuée l'apparition de très importants bancs de jeunes thons rouges (*Thynnus thynnus* Lin.) de 1.5 à 3 kg. dans la zone

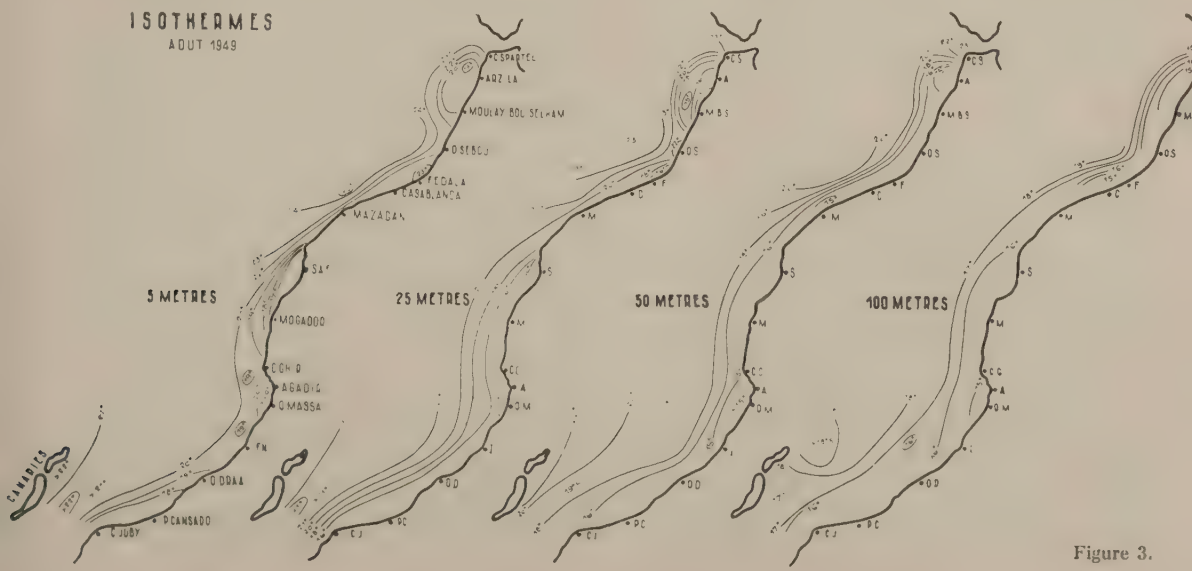


Figure 3.

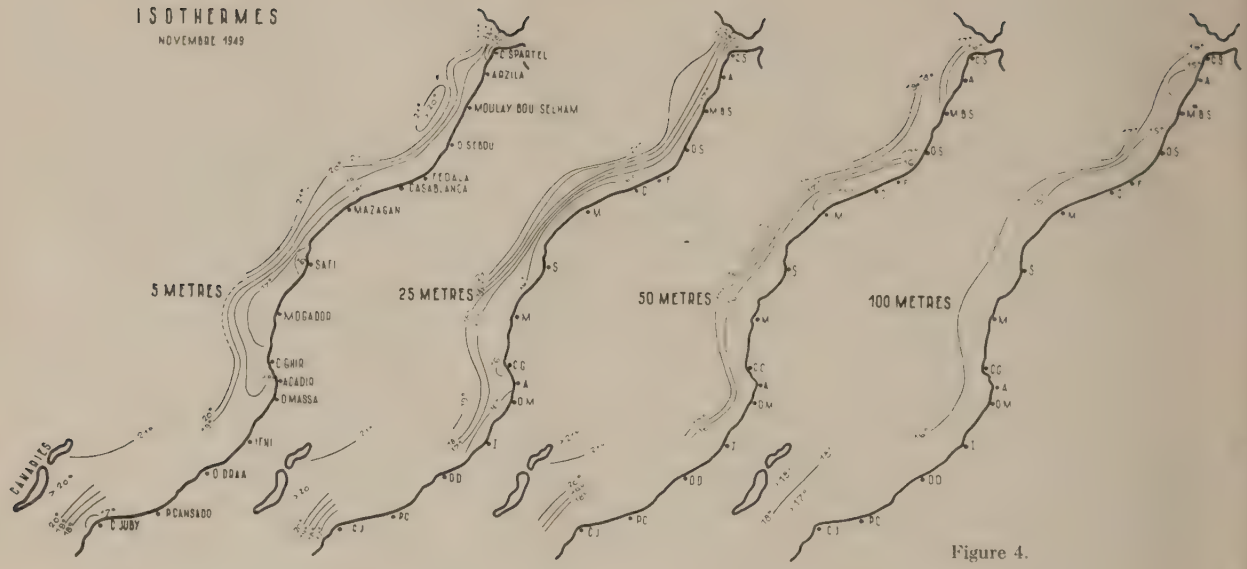


Figure 4.

côtière septentrionale ainsi que celle de germons (*Germo alalunga* Gml.) dans le secteur sud.

De même l'épanouissement en surface des eaux à 16° d'origine profonde, limité à une étroite bande côtière, dans les parages de Safi-Mogador a eu pour conséquence une concentration beaucoup plus dense de sardines adultes dans une zone peu étendue où de très fortes captures ont pu être faites.

Jean Furnestin.

Fishery Hydrography: Brood-Strength Fluctuations in the Hake with a suggested Method of Prediction.

In this paper brood-strength fluctuations in the hake born to the south and west of Ireland are associated with inferred water movements set up by the local wind. This follows closely upon similar investigations which the author, in association with J. N. Carruthers and A. L. Lawford, carried out on the haddock, herring, plaice and cod of the North Sea. The analysis on the haddock is due to be published shortly by the Scottish Home Department and the work on the remainder will appear in the journal *Kieler Meeresforschungen*. This method of attack on the problem of brood fluctuations arose from the ideas on Fishery Hydrography expressed at the 1950 meeting of the International Council for the Exploration of the Sea at Copenhagen.

The figures used to represent the hake broods for 1921—1930 were those given in the *Rapports et Procès-Verbaux* Vol. CI, 1936 and are the year-class strengths relative to 1921 taken as 10. The wind data are those for the western section of the English Channel centred on 50° N., $3^1/_2$° W., and were computed in the form of monthly cardinal components by Dr. Dietrich of Hamburg.

In his Buckland lectures Hickling showed that there was a good correlation between the average temperature of the sea during the first year of life of each year's brood of hake, and the catches of small hake five years later. The average temperature was ascertained from the temperature observations taken at the Seven Stones lightship and was for the period April-March inclusive. The catches of small hake were the only estimatesof brood strength available at that time.

Using the new brood figures the correlation between the year-class strengths and the average temperature is shown in Figure 5. Is it seen that a high degree of parallelism exists between the two variables, but this parallelism breaks down for the years 1928 and 1929. Moreover

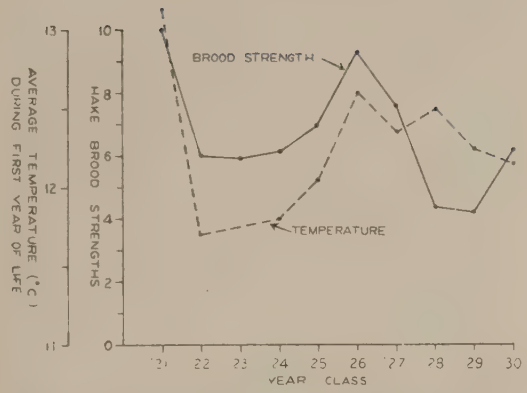


Figure 5. Association between Hake Brood Strength and Average Sea Temperature during first year of life.

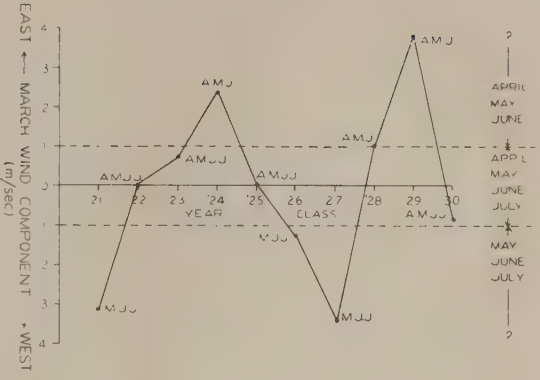


Figure 7. Association between East/West Wind Component in March and Month to be selected.

the line of the average temperature rises only above the line representing the brood strength on three occasions—1921, 1928 and 1929. It was considered that these anomalies might have been due to the wind conditions obtaining during the spawning period April to July inclusive.

HICKLING's explanation of the anomalies in 1928 and 1929 was that the monthly east wind components occurring during the spawning periods of those years prevented some of the spawning products from reaching the coastal waters at a critical stage of their existence. The result was for the brood strength values to fall below those expected from the temperature correlation. This happened also in 1921 where again there were monthy east wind components at the times of spawning.

In view of this it was decided to attempt a correlation between the difference of the actual hake brood values and the values given by the temperature line in Figure 5, and the resultant east/west wind component during April to July. This correlation is shown in Figure 6, and it was found that it would be strengthened by

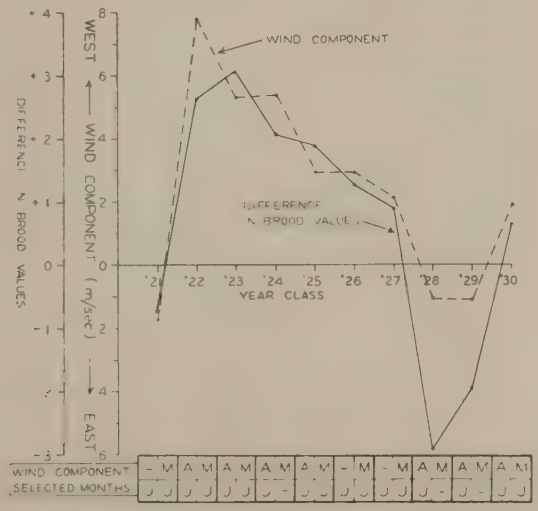


Figure 6. Association between Difference of actual Value of Hake Brood and Value given by Temperature Correlation, and Resultant East/West Wind Component for months selected.

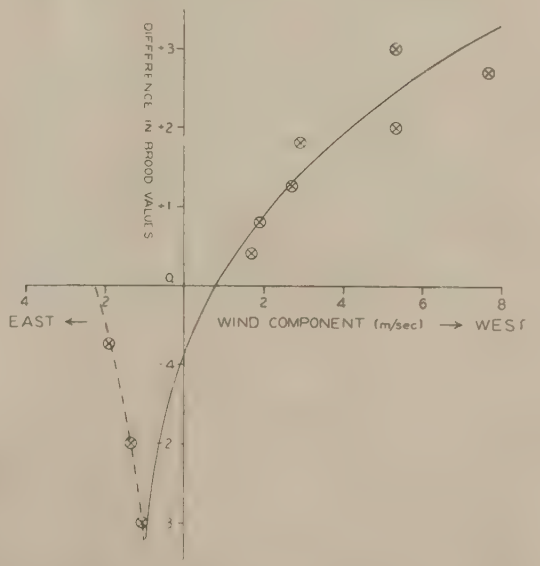


Figure 8. Analysis of Association shown in Figure 6.

assuming that sometimes the hake spawned early, in which case the months to be considered were April to June, and sometimes late, when only the components for May to July were effective. At all other times the winds for the full period April to July were considered.

One question remains—what determines the inferred variation in the time of spawning? Here the main factor appears to be the east/west component during March. If this component has an easterly value of 1 m./sec. or over then spawning will be early. If the value lies between 1 m./sec. east and 1 m./sec. west then the months to be considered are April to July inclusive. In cases where the component exceeds 1 m./sec. west the spawning will be late. The explanation would appear to be that the hake swims against the wind direction during its spawning migration which is assumed to be in an easterly direction. Therefore an easterly wind will accelerate its arrival at the main spawning ground whilst a westerly wind will delay it. Figure 7 shows the value of the east/west component in March for the years 1921 to 1930 with the selected months shown against each point.

In order to analyse the correlation in Figure 6 the two variables were plotted against each other in Figure 8 and two regression lines drawn in. Although the positive line may be taken as significant the negative one is doubtful. A possible explanation of its existence would be that when the winds during the spawning period have a large resultant west wind component the brood is carried towards the shallow waters of the English west coast, which is a beneficial transport and brings the actual hake value far above the value predicted from the temperature correlation. If, however, there is a resultant east component of about 1 m./sec. a high proportion of the brood may not be carried into any coastal waters, but may remain in the open sea at a stage which is critical for survival, thereby causing a high degree of mortality. With an east component of greater than 1 m./sec., the brood would probably be carried to the waters of the south and east coasts of Ireland; this would presumably lead to a good survival and would bring the actual value of the brood close to the value predicted by the temperature correlation.

For prediction purposes the following operations would be necessary:—

(a) Using the value of the east/west wind component in March determine (from Fig. 7) the spawning months to be selected.
(b) Compute the value of the resultant east/west component for the selected months.
(c) From the graph in Figure 8 read off the value of the difference of the actual brood strength and the strength predicted from the temperature correlation.
(d) From temperature observations at the Seven Stones Light Vessel, compute the value of the average temperature during the first year of life and using the temperaature correlation in Figure 5, read off the apparent value of the brood strength obtained.
(e) From the results of (c) and (d), calculate the actual predicted brood strength.

As regards the accuracy of prediction it is seen that the maximum deviations from the regression lines in Figure 8 are $\pm$ 0.5, but to use any of the above analyses for reliable quantitative prediction purposes is impossible without further establishing the rules for prediction and the regression lines themselves. However, given more data of the required standard, it does appear that it may be possible to predict the fortunes of the hake industry from a knowledge of the temperature conditions during the first year of life and the wind conditions for the spawning period.

V. F. C. Veley. (London).

Planeton.

Le Zooplancton de la Zone Côtière du Maroc

Anné 1949 – 3° note.

L'étude du zooplancton des côtes marocaines a été poursuivie en 1949 selon les mêmes méthodes qu'en 1947 et 1948: — analyses quantitatives en volume, détermination et numération des formes planctoniques, établissement de cartes de répartition en fonction de la température de l'eau, du lieu et de la saison de nos prélèvements. Ces prélèvements effectués en surface, avec un filet de 30 cm. de diamètre tiré toujours à la même vitesse pendant 5 minutes, sont tous comparables.

Il en a été fait 4 séries trimestrielles (Février-Mai-Août-Novembre); chacune comportant 16 lignes de stations perpendiculaires à la côte — à raison de 3 à 6 stations par ligne — entre Tanger et le Détroit Canarien.

I. Répartition saisonnière du zooplancton

(figure et tableau).

Hiver: Le plancton est abondant; sa quantité, légèrement croissante du nord au sud, dépasse celle des 2 hivers précédents.

Le maximum saisonnier de nombreuses formes se place en cette saison: Oikopleura, Décapodes, œufs de poissons.

Cette richesse hivernale croissante de 1947 à 1949 trouve une explication plausible dans l'hydrologie côtière: la poussée annuelle des eaux chaudes subtropicales reconnue sur le littoral marocain, qui ne s'amorce généralement qu'à la fin de l'hiver ou même au début du printemps, a présenté, déjà en 1948 mais surtout en 1949, une remarquable précocité.

Ainsi les eaux côtières, réchauffées dès l'hiver, ont vu le développement plus intense de certaines espèces.

Printemps: La densité du plancton est légèrement supérieure à celle de l'hiver; sa répartition devient très inégale avec un premier maximum au nord (ligne du Cap Spartel) et un maximum secondaire au centre(Safi-Mogador).

La poussée des eaux chaudes transgressives se manifestant dans toute sa puissance favorise la pullulation de plusieurs formes: Cladocères, Diphyes, œufs de poissons.

Eté: La quantité de plancton est faible et sa distribution demeure inégale; hors une certaine abondance de Salpes dans le secteur central, la presque totalité du plancton se trouve dans le secteur nord.

Cette pénurie estivale rappelle celle de 1948 mais est encore plus accentuée.

Automne: D'une richesse comparable à celle des premières saisons de l'année, le plancton d'automne présente le maximum saisonnier des Sagitta et Copépodes.

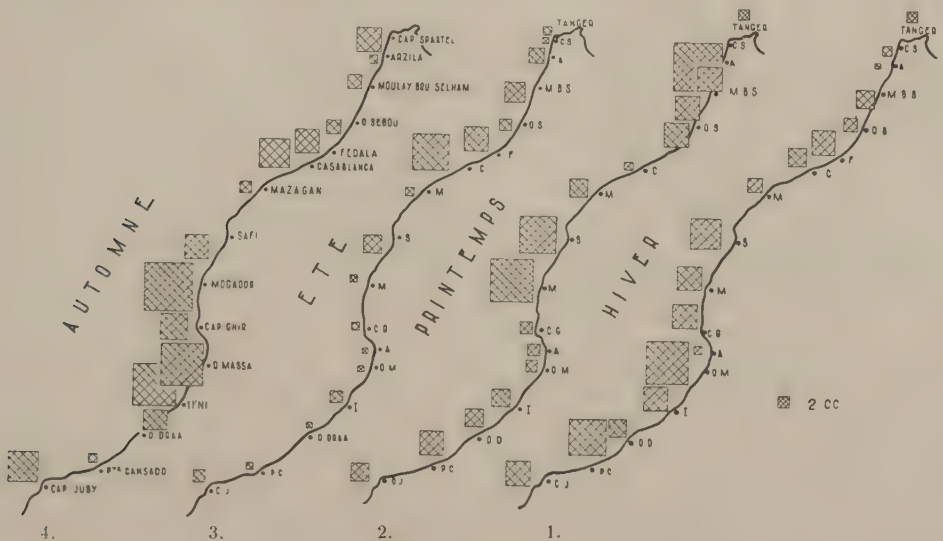


Figure 9. Zooplancton. Variations saisonnières 1949.

L'année 1949 offre donc trois saisons de richesse sensiblement équivalente et une saison pauvre.

Au total l'abondance du plancton est en très légère hausse sur celle des années 1947 et 48.

II. Répartition géographique du zooplancton (figure et tableau).

(a) Proportionnellement au nombre de prélèvements effectués dans chacun d'eux, les trois secteurs, nord, centre et sud de la côte marocaine sont de richesse sensiblement égale.

Il n'y a pas, comme en 1947 et 1948, d'opposition marquée entre des secteurs nord et sud riches et un secteur central pauvre.

(b) On observe un déplacement saisonnier des zones de plus grande concentration qui, du sud en hiver, passent au nord au printemps et en été, pour revenir vers le sud en automne. En particulier, suivent très nettement ce mouvement, les Diphyes, Sagitta, Copépodes, Décapodes.

Il est vraisemblable que les positions géographiques successives des groupes planctoniques sont liées aux mouvements alternés des eaux de la région marocaine: — ou bien les eaux chaudes du sud entraînent avec elles les formes planctoniques vers le nord puis les ramènent vers le sud, ou bien elles favorisent leur éclosion et leur pullulation sur place en leur apportant les conditions de vie les plus favorables.

Ces migrations ou éclosions planctoniques ne présentaient pas la même netteté les années précédentes (surtout en 1947). Ces différences annuelles s'expliqueraient par la précocité et la force de plus en plus grandes de la poussée des eaux du large de 1947 à 1949. Les mouvements corrélatifs du plancton se sont, dès lors, trouvé accentués, précisés d'une année à l'autre.

(c) D'autres modalités dans la répartition des indicateurs de plancton sont certainement en rapport avec les modifications saisonnières de l'hydrologie côtière marocaine.

Tableau I. Analyses quantitatives (en cm^3).

Lignes	Hiver	Printemps	Eté	Automne
Secteur Nord				
Tanger	5	6	0.5	—
Spartel	2.5	76	1	14
Arcila	0.25	22.5	6	3
M. B. Selham	5.5	15	12	7
O. Sebou	3	16	4	5
Fedala	15	2.5	14	17
Casablanca	10.5	34.5	42	26
Secteur Central				
Mazagan	6	39.5	27	5
Safi	23.5	36	7.5	16
Mogador	15	41	2	61
Secteur Sud				
Cap Ghir	46	5.5	1	28
Agadir	2	6	0.5	61
O. Massa	71.5	3.5	1	60
Ifni	14.5	13.5	4	15
O. Draa	11	11	1	—
P. Cansado	62.5	15	2	0.5
Cap Juby	27	19	5	23
Total	320.75	363.5	130.5	341.5

L'une des plus significatives est l'existence anormale au voisinage de la côte, à certains moments, de formes planctoniques de haute mer à peu près dénuées de mouvements propres et donc soumises à ceux de leur habitat. (Diphyes, Oikopleura, Salpes).

Or la venue à la côte et le retour au large de ces organismes coïncident précisément avec l'envahissement de la zone côtière par les eaux transgressives, puis avec la régression qui lui fait suite.

Notons enfin que le cycle saisonnier de la plupart des espèces indicatrices n'est pas, comme on pourrait s'y attendre, le même chaque année et que le cycle hydrologique saisonnier a également varié d'une année à l'autre. Ce qui semble bien prouver une corrélation entre hydrologie et plancton.

Marie-Louise Faure.

LES POISSONS

GADIDÉS

Merlu (*Merlucius merluccius* (L)).

Le Stock en 1950.

En 1950, les captures de merlu par les chalutiers de La Rochelle ont été comparables, sinon légèrement inférieures à celles de l'année précédente. Elles représentent 45% de la pêche totale d'un chalutier à vapeur de 300 tx environ; la moyenne annuelle fut de 6 tonnes par sortie contre 6.3 tonnes en 1949.

L'exploitation du stock de merlu s'est donc stabilisée à un faible niveau au cours de ces deux dernières années puisqu'en 1946 les mêmes chalutiers réalisaient une moyenne de 23 tonnes par sortie de pêche.

Les mensurations effectuées dans le Golfe de Gascogne en 1950 montrent bien cette similitude du stock d'une année à l'autre (Fig. I).

En 1950, 64% des captures se composaient de poissons de 25 à 50 cm., 24% de poissons de 50 à 70 cm. et 12% de poissons de plus de 70 cm.

Quelques bonnes pêches furent faites cependant sur la côte NW. de l'Espagne et entre le banc Porcupine et la Grande Sole. Dans ce dernier secteur, la proportion des individus de 50 à 70 cm. était beaucoup plus importante que dans les pêches du Golfe de Gascogne. De 25 à 50 cm., on ne trouve en effet que 32%

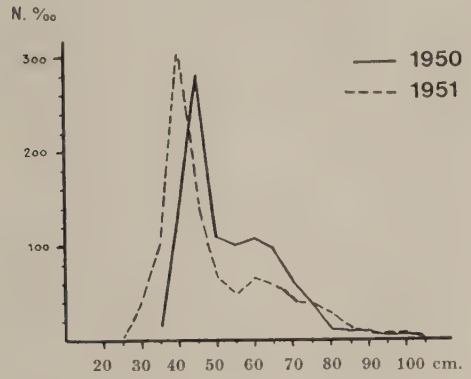


Figure I.

Mensurations effectuées en 1950.

Origine:	Banc Porcupine à Grande Sole. 150—300 m. 11.IX au 2.X.	Golfe de Gascogne. 46 à 45° N. 2 à 3° W. 250—400 m. 1. au 13.XII.
cm.		
15	—	1
20	—	2
25	1	3
30	25	40
35	48	106
40	68	315
45	99	145
50	175	70
55	221	50
60	139	70
65	118	58
70	70	45
75	15	44
80	7	29
85	6	11
90	1	6
95	3	3
100	—	1
105	4	—
110	—	1
Total.....	1000	1000

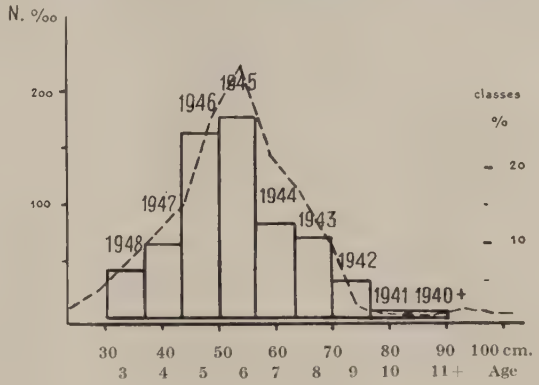


Figure II.

Répartition par classes des Merlus capturés entre le banc Porcupine et la Grande Sole en 1950.

Prélèvement effectué du 11.IX au 2.X.

Classe:	1948	1947	1946	1945	1944	1943	1942	1941	1940+	
Age:	3	4	5	6	7	8	9	10	11+	ans
cm.										
30.....	4	1	—	—		—	—		-	
35.....	7	5	1	—	—	—	—			
40.....	3	9	13	—	—		—			
45.....	—	4	10	3	—	—	—	—	-	
50.....	1	3	15	18	2	—	—	—	—	
55.....	—	—	15	23	6	2	—	—	—	
60.....	—	—	1	8	7	6	—	—	—	
65.....	—	—	—	7	13	8	4	1	—	
70.....	—	—	—	—	2	8	7	—	—	
105.....	—	—	—	—	—	—	—	—	2	
Total.....	15	22	55	59	30	24	11	1	2	219
%.....	7	10	25	27	13	11	5	1	1	100
Taille moyenne .	36	40	48	54	61	64	68	(65)	105	cm.

d'individus, mais 60% de 50 à 70 cm. Au dessus de 70 cm. on ne trouve plus par contre que 8% de merlus de grande taille.

La taille modale du stock ainsi mesuré est de 55 cm. Elle correspond à la taille moyenne des merlus de 6 ans qui, avec ceux de 5 ans (taille moyenne 48 cm.), représentent la moitié du matériel examiné. (Fig. II).

Cette différence apparente entre la pêche dans le Golfe de Gascogne et celle au large de l'Irlande n'est pas due à l'exploitation d'un stock local plus riche dans ce dernier secteur. Elle doit être attribuée au fait que les chalutiers allant dans les secteurs les plus éloignés de La Rochelle sont des chalutiers plus puissants et pouvant travailler en eaux plus profondes que ceux restant dans le Golfe de Gascogne. C'est ainsi que le rendement de la pêche qui a été, comme nous l'avons dit, de 6 tonnes de merlu par sortie pour un chalutier de 300 tx environ, a été par contre de 9 tonnes au cours de la même année 1950 pour un chalutier de 450 tx.

Cette différence de rendement ne tient compte que de la différence de puissance des unités actuellement en service et rien ne permet de mettre en doute la pauvreté actuelle de stock de merlu.

R. Letaconnoux.

CLUPÉIDÉS

Sardine (*Clupea=Sardina pilchardus* Walb).

En se basant uniquement sur des considérations d'ordre géographique, les résultats des observations, faites sur les lieux de rassemblements et de pêche de la sardine (*Clupea pilchardus* Walbaum) ont été groupés par secteurs, à savoir:

I — Manche et Mer du Nord.
II — Bretagne: de la Baie du Mont St-Michel à l'embouchure de la Loire.
III — Vendée: de l'embouchure de la Loire à l'embouchure de la Gironde.
IV — Fond du Golfe: de l'embouchure de la Gironde à
V — Côte ouest de la Péninsule Ibérique Espagne et Portugal.
VI — Maroc.
VII — Méditerranée.

Golfe de Gascogne.

I. Corrélation Taille-Poids.

Le collationnement de plusieurs milliers d'observations faites depuis 1920 par l'Office Scientifique et Technique des Pêches Maritimes, sur la taille et le poids des sardines débarquées dans les ports du littoral français de l'Atlantique, a permis d'établir avec précision la corrélation Taille/Poids des sardines de 10 à 20 centimètres de long, constituant les bancs rencontrés, de Mai à Novembre, sur les côtes françaises, depuis St-Jean-de-Luz, au sud, jusqu' à la Baie de Lannion, sur la côte nord de Bretagne, limite septentrionale de la pêche de ces poissons aux filets droits.

Cette corrélation a été étendue à la notion de «Moule»: «Moule Filet» et «Moule Poids» (nombre de sardines au kilogramme), pratiquement employées par les pêcheurs pour qualifier la sardine au débarquement.

Tableau 2.

Moule Filet	Taille cm.	Poids Grammes	Nombre au kilo	Moule Filet	Taille cm.	Poids Grammes	Nombre au kilo
	200				145	23.0	40 à 47
76		56.0		54		22.2	
	195				140	20.0	47 à 52
74		54.5	14 à 16	52		19.5	
	190				135		52 à 58
72		52.0		50		17.0	
	185				130		58 à 65
70		49.0		48		15.5	
	180	48.0	18 à 20		125	14.5	65 à 73
68		43.0		46		13.0	
	175	42.5	20 à 22		120		73 à 82
66		38.5		44		11.5	
	170	37.0	22 à 25		115		82 à 94
64		36.0		42		10.0	
	165	34.5	26 à 29		110		94 à 110
62		33.0		40		8.0	
	160	30.5	29 à 32		105		110 à 135
60		29.0		38			
	155	27.5	32 à 35		100		135 à 160
58		27.0		36			
	150		35 à 40		95		160 à 200
56		24.8	"	34			
					90		

Elle nous a permis d'évaluer facilement et avec une approximation suffisante, contrôlée par les mensurations de prélèvements périodiques, la taille moyenne des sardines qui, de Mai (début de la saison de pêche) à Novembre (fin de la saison) se sont succédées dans les quatre secteurs de pêche du littoral atlantique.

Tableau 3.

Taille en cm.	Mai	Juin	Juillet	Août	Sept.	Oct.
	18 à 20	centimètres	(sardines adultes)			
	15 à 16	»	(sardine profonde)			
Douarnenez-Guilvinec-Concarneau....	—	14.8	15.5—15.5	15.5	16—16.5	16—16.8
Quiberon-Belle-Isle-La Turballe.....	13.8—14	14—14.5	14—14.5	14.5—15	15—15.5	16—16.5
Sables Olonne-Croix de Vie-Yeu.....	13—13.5	13—13.5	13.5—14	14.5—14.8	16 15—16	12.5 fin saison
Arcachon.....	12.5—13	12.5—13	14.5 13	—	13.5—14	14.5

Ce qui montre que la taille moyenne de ces sardines diminue progressivement du nord au sud, tandis que sa croissance, quelle que soit son origine, est progressive (2.5 cm. environ) de Mai à Octobre dans chacun de ces secteurs et du sud au nord (Figure 10).

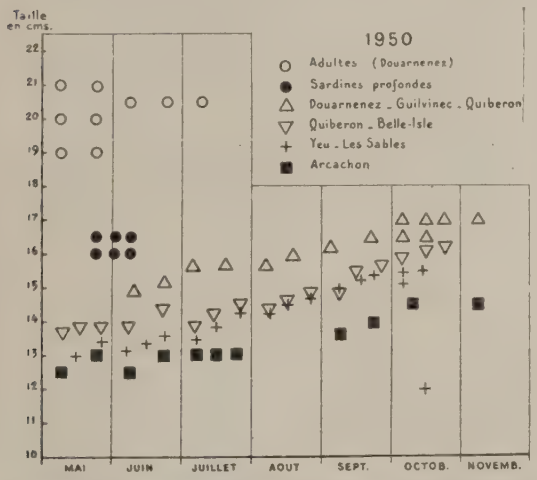


Figure 10. Variations du «Moule» sur les Pêcheries Golfe de Gascogne.

II. Côte de Vendée.

Origine: Parages de l'Ile d'Yeu (entre cette île et la côte: Anse des Vieilles. Bouée des Bœufs, les Baleines, Sables d'Olonne).

Dates:

Lot A: Juin-Juillet 1950
Lot B: Août 1950
Lot C: Septembre 1950

Engins: Filets droits
Moules: 48/50, 50/52, 52/54.
Observateur: R. Poisson.

Taille.

Mesurée du bout du museau à l'extrémité de la queue, longueur ramenée au demi-centimètre inférieur. (Voir le Tableau 4 en bas de la page.)

Age.

Les sardines du Lot A prélevées en Juin 1950 étaient en grande majorité (90%) des poissons, d'un an révolu (Groupe I) avec quelques poissons de moins d'un an (Groupe 0) et quelques sardines plus âgées.

Ces sardines de deux et trois ans sont plus nombreuses dans les lots B (Août) et lot C (Septembre).

Tableau 4. Répartition générale.

Représentation %	Longueur en centimètres													Long.
	115	120	125	130	135	140	145	150	155	160	165	Mode	Moyenne	Moyenne
Lot A— Juin 1950 %....	0.2	1.3	13.5	44.5	26.5	8.2	4.1	1.4	0.2	0.1	—	130	13.23	13.73
Lot B— Août 1950 %....	—	—	—	0.1	13.0	28.0	32.2	20.3	5.3	0.5	—	145	14.32	14.82
Lot C— Sept. 1950 %....	—	4.2	6.0	7.0	4.4	11.3	20.4	23.7	16.0	6.0	1.0	130/150	14.45	14.95
Ensemble %.....	0.1	1.8	6.5	17.2	14.6	15.8	19.2	15.1	7.2	2.2	0.3	130/150	14.07	14.57

N= 1,277

Tableau 6. Répartition suivant longueur calculée à la formation du 1er anneau d'hiver sur l'écaille (l_1)

Représentation %	Valeurs de l_1											Mode	Moyenne	Long. Moyenne
	70	75	80	85	90	95	100	105	110	115	120			
Lot A %.....	1.9	2.8	8.2	12.9	15.0	21.9	19.1	11.3	4.4	0.2	0.3	95	9.35	9.85
Lot B %.....	5.0	8.3	16.7	16.7	21.7	16.7	11.7	3.3	—	—	—	90	8.77	9.25
Lot C %.....	11.8	11.8	13.7	21.6	19.6	7.8	7.8	3.9	—	2.0	—	85	8.62	9.12
Ensemble %.....	6.1	7.6	12.8	17.0	18.7	15.5	12.8	6.2	1.5	0.7	0.1	90	8.91	9.40

Tableau 5. Répartition dans chacun des groupes: Gr. 0 et Gr. I.

Représentation %		Longueur en centimètres 115	120	125	130	135	140	145	150	155	160	165	Mode	Moyenne	Long. Moyenne
Gr. 0	Lot A %	3.4	13.3	25.0	30.0	20.0	8.3	—	—	—	—	—	130	12.87	13.38
	Lot B %	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lot C %	—	26.8	30	30	6.6	3.3	3.3	—	—	—	—	125/130	12.69	13.19
Ensemble %		1.7	20.0	27.5	30	13.3	5.8	1.6	—	—	—	—	130	12.78	13.28
Gr. I.	Lot A %	—	2.2	26.0	45.5	16.3	5.0	4.1	0.9	—	—	—	130	13.59	14.09
	Lot B %	—	—	—	—	8.3	25.0	33.4	25.0	8.3	—	—	145	14.50	15.00
	Lot C %	—	—	—	4.0	4.0	4.0	30.2	35.9	17.9	4.0	—	150	14.78	15.28
Ensemble %		—	0.7	8.7	16.5	9.5	11.0	22.6	20.6	8.7	1.3	—	130/145	14.29	14.79

Marquages.

718 sardines ont été marquées en Septembre et Octobre 1950 au large de La Rochelle.

Les marques utilisées étaient constituées par une plaquette de celluloïd jaune de 5 mm. ×25 mm. portant un numéro précédé des lettres R. F., gravées sur chaque plaquette et d'une agrafe en fil d'acier inoxydable de $^4/_{10}$ mm. de diamètre en broche (type A) ou à double pointe formant ressort (type B).

Elles ont été fixées dans le dos du poisson entre la nuque et la nageoire dorsale.

Deux mois après les derniers marquages, trois poissons marqués ont été recapturés dans les mêmes parages.

JEAN LE GALL.

Nourriture de la Sardine.

L'examen microscopique des contenus stomacaux d'un échantillon de 151 sardines de 13 à 26 cm. de longueur capturées les 15 et 17 Février 1949 dans les parages de Belle Isle (Ann. Biol. Vol. VI, 1949, p. 54) montre, outre la farine d'arachide et les œufs de morue employés comme appât, la présence des espèces suivantes:

— Cirripèdes (stade Cypris): abondants
— Débris de Copépodes: *Temora longicornis* MÜLLER dominant, *Paracalanus parvus* CLAUS; *Centropages typicus* KRØYER; *Euterpina acutifrons* DANA.
— Débris de Brachyures au stade Zoé avec quelques Diatomées centriques.

J. FLEURY.

La Sardine de Santander en 1950.

La saison sardinière a été déficitaire, encore une fois, soit à cause du manque ou de la disette de la rogue, soit par la rareté des Delphinidés qui traquent les bancs de Clupéides et les signalent ainsi aux pêcheurs.

Nos observations pour la période Décembre 1949—Août 1950, ont été faites sur huit échantillons provenant de la pêche à la rogue au filet tournant.

La **répartition des tailles** (Tableau 7) montre que le stock exploité en printemps et en été appartient à une seule classe d'âge, qui croît de 14 cm. en Avril à 17.5 cm. en Août et, d'a-

Tableau 7. Répartition des tailles.

Date	1949	1950					
Taille mm.	$^{12}/_{12}$	$^{10}/_{4}$	$^{25}/_{4}$	$^{1}/_{6}$	$^{19}/_{6}$	$^{6}/_{7}$	$^{29}/_{7}$	$^{25}/_{8}$
90	2	—	—	—	—	—	—	—
95	4	—	—	—	—	—	—	—
100	1	—	—	—	—	—	—	—
105	—	—	—	—	—	—	—	—
110	1	—	—	—	—	—	—	—
115	—	1	—	—	—	—	—	—
120	—	—	—	—	—	—	—	—
125	—	6	—	—	—	—	—	—
130	—	12	—	1	—	—	—	—
135	—	13	—	3	—	—	—	—
140	—	38	5	2	—	—	—	—
145	—	18	17	24	—	—	—	—
150	—	10	28	32	1	4	—	—
155	2	1	37	24	16	13	—	—
160	—	1	14	12	41	26	1	—
165	—	—	4	3	35	34	8	4
170	1	—	—	—	7	11	40	24
175	4	1	—	—	2	12	40	35
180	7	1	—	—	—	2	9	30
185	15	—	—	—	—	—	1	5
190	28	—	—	—	—	—	—	2
195	23	—	—	—	—	—	—	—
200	8	—	—	—	—	—	—	—
205	3	—	—	—	—	—	—	—
210	4	—	—	—	—	—	—	—
215	2	—	—	—	—	—	—	—
N =	105	102	105	101	102	102	100	100
Moy.	184	140	154	151	164	165	173	176

près ce que nous avons déjà appris (v. *Annales Biologiques*, Vol. VI), est entrée dans la pêcherie en Octobre 1949, bien qu'elle ne soit pas représentée dans l'échantillon de Décembre. Les petites sardines (9—11 cm.) trouvées à cette date représentent une nouvelle classe, ou bien sont nées de pontes tardives.

Sous réserve de rectification, nous pouvons dire que le stock exploité à Santander est constitué par des sardines de 12 à 15 cm. entrées dans la pêcherie en Septembre-Octobre. Cette classe atteint 18—19 cm. au bout d'un an et disparait rapidement au cours de l'hiver suivant. La cause de la disparition (migration, mortalité naturelle ou capture) est à rechercher.

Tableau 8. Caractères sexuels.

	Mâles			Femelles		
Date	N	TM	Mm	N	TM	Mm
1949						
$^{12}/_{12}$	43	187	3.9	52	195	4.7
1950						
$^{10}/_{4}$	39	140	1.2	54	140	1.4
$^{25}/_{4}$	43	155	2.7	62	154	2.2
$^{1}/_{6}$	38	151	5.5	63	150	6.9
$^{19}/_{6}$	47	161	2.0	55	165	2.0
$^{6}/_{7}$	32	164	2.0	70	165	2.3
$^{29}/_{7}$	40	170	2.1	60	172	2.6
$^{25}/_{8}$	63	175	2.1	37	174	2.8
	345			453		

N = nombre. TM = taille moyenne.
Mm = maturité sexuelle moyenne.

Répartition des sexes. Le Tableau 8 montre que les femelles sont ordinairement plus nombreuses que les mâles; l'échantillon du 25 Août fait exception. Au total, les pourcentages respectifs sont 56.8 et 43.2.

Le manque d'observations en hiver empêche de suivre le processus complet de la maturation sexuelle. Les grosses sardines du 12 Décembre étaient dans un état de maturité assez avancé; les testicules pesaient en moyenne 1.9 g. et les ovaires 2.1 g., chiffres encore éloignés du maximum qui n'est atteint qu'en Février ou en Mars.

Les observations faites sur les sardines de la nouvelle génération indiquent que la ponte a eu lieu vers la fin de Mai. Le 1er Juin, un grand nombre des individus examinés était au stade VIII. Pendant la période estivale, les gonades restent au repos.

En se basant sur les études faites à Santander au cours de ces dernières années, on peut admettre que la période de ponte est très longue, depuis le début de l'hiver jusqu'à la fin du printemps. Les sardines atteignent au printemps leur première maturité sexuelle à l'âge de 15—18 mois, quand leur taille est de 15—16 cm. Une deuxième ponte a lieu en hiver, à l'âge de deux ans à peine révolus, correspondant à une taille de 19 cm.

Formule vertebrale. La formule vertébrale établie pour les divers prélèvements et pour l'ensemble est donnée dans le Tableau 9. La valeur moyenne absolue est égale à celle obtenue en 1948—1949.

Tableau 9. Formule vertébrale.

Date	49	50	51	52	53	N	Moy.
1949							
$^{12}/_{12}$	—	—	12	77	8	97	51.95
1950							
$^{10}/_{4}$	1	—	15	73	9	98	51.91
$^{25}/_{4}$	—	1	19	77	8	105	51.88
$^{1}/_{6}$	—	1	11	77	12	101	51.99
$^{19}/_{6}$	—	—	14	83	5	102	51.91
$^{6}/_{7}$	—	9	37	54	2	102	51.48
$^{29}/_{7}$	1	6	38	53	2	100	51.49
$^{25}/_{8}$	—	6	37	55	2	100	51.53
Total.....	2	23	183	549	48	805	51.77

En Juillet 1950, de même qu'en Juillet 1949 (v. *Annales Biologiques*, Vol. VI), s'est produite une chute remarquable de cette valeur moyenne. Celle-ci, qui était 51.921 pour les quatre lots d'Avril-Juin, est tombée à 51.500 pour les trois échantillons de Juillet-Août; l'écart est de 0.421.

Les erreurs standard affectant ces valeurs moyennes sont ± 0.025 et ± 0.038 respectivement. La racine carrée de la somme des carrés des erreurs vaut ± 0.045, chiffre presque dix fois plus petit que l'écart 0.421. Donc, il devient extrêmement probable — pour ne pas dire absolument certain — que les deux populations représentées par les lots en question sont réellement — non casuellement — différentes quant à leur forme vertébrale.

Il faut remarquer que ces sardines à faible moyenne vertébrale disparurent très vite de la pêcherie en 1949; tandis qu'en 1950, elles ont persisté durant Juillet et Août au moins. Il reste à trouver d'où elles viennent et où elles vont.

R. Fernandez et F. Navarro.

La Sardine de Vigo en 1950.

Six échantillons (694 sardines) ont été étudiés de Février à Juin 1950 au Laboratoire de Vigo sur du matériel prélevé des pêches au filet tournant à l'embouchure de la Ria de Vigo.

Tableau 10. Répartition des tailles.

Date	21/2	3/3	28/3	23/4	12/5	21/6	Total
120	1	—	—	—	—	—	1
125	1	—	—	—	—	—	1
130	4	2	2	—	—	—	8
135	8	6	9	—	1	—	24
140	8	22	34	—	7	1	72
145	11	20	26	5	26	8	96
150	16	23	14	10	47	38	148
155	10	12	6	23	20	40	111
160	7	6	2	27	16	10	68
165	17	3	5	25	23	1	74
170	8	2	1	7	22	2	42
175	2	—	1	2	12	—	17
180	3	1	—	1	12	—	17
185	—	—	—	—	6	—	6
190	—	—	—	—	5	—	5
195	1	—	—	—	3	—	4
N =	97	97	100	100	200	100	694
Moy. =	155	149	147	161	161	155	

Taille et âge.

La répartition des tailles à chaque échantillon et dans l'ensemble est exposée au Tableau 10. Il faut remarquer un substantiel rehaussement des valeurs moyennes par rapport à la même période des années précédentes. Si le matériel étudié est véritablement représentatif du stock, cette constatation révélerait une amélioration des conditions de croissance de la sardine, ou bien un avancement de la période de ponte en 1949.

Le Tableau 11 indique la répartition des sardines par taille et par âge. Durant les mois de Février et Mars, les groupes 0 et I sont confondus car le premier anneau d'hiver lorsqu'il existe est justement sur le bord de l'écaille; seules quelques sardines dépassant 16 cm. appartiennent vraiment au groupe I, c'est-à-dire sont âgées d'environ deux ans. En Avril et en

Tableau 11. Répartition par âge et par taille.

Date	21/2		3/3		28/3		23/4	12/5		21/6	
Age	0	I	0	I	0	I	I	I	II	I	II
120	—	1	—	—	—	—	—	—	—	—	—
125	1	—	—	—	—				—		
130	4	—	2	—	1	1	—	—	—	—	—
135	8	—	5	1	8	1	—	1	—	—	—
140	8	—	18	4	23	11	—	7	—	1	—
145	10	1	19	1	19	7	5	26	—	8	—
150	14	2	19	4	11	3	10	47	—	38	—
155	8	2	12	—	3	3	23	20	—	40	—
160	6	1	4	2	2	—	27	15	1	10	—
165	17	—	2	1	5	—	25	21	2	1	—
170	8	—	—	2	1	—	6	16	6	1	1
175	1	1	—	—	—	1	2	11	1	—	—
180	3	—	—	1	—	—	1	8	4	—	—
185	—	1	—	—	—	—	—	5	1	—	—
190	—	—	—	—	—	—	—	2	3	—	—
195	—	—	—	—	—	—	—	1	2	—	—

Tableau 12. Poids moyen des sardines entières (P) et vidées (P').

Date:	21/2		3/3	28/3		23/4		12/5	31/6
Poids:	P	P'	P	P	P'	P	P'	P	P
130	19.0	13.5	18.5	19.0	14.0			—	—
135	19.8	16.8	18.8	20 1	14.8	—	—	—	—
140	22.7	19.7	21.9	22.9	17.0	—	—	20.2	24.0
145	25.3	21.0	23.8	24.7	18.4	28.4	24.0	22.0	25.5
150	27.1	23.9	26.8	27.0	19.2	29.9	25.4	23.9	27.8
155	29.6	24.3	29.0	29.5	20.6	32.3	27.3	26.3	29.9
160	33.0	28.7	32.5	32.0	23.5	35.5	29.0	31.1	31.9
165	34.5	29.1	37.0	35.8	25.2	39.4	31.8	34.0	34.0
170	36.8	28.6	38.5	40.0	26.0	42.4	34.1	36.3	35.5
175	—	—	—	44.0	32.0	43.0	35.5	41.2	—
180	—	—	41.0	—	—	50.0	41.0	45.0	—
185	—	—	—	—	—	—	—	48.3	—
190	—	—	—	—	—	—	—	54.4	—
195	—	—	—	—	—	—	—	56.0	—

Mai, l'anneau hivernale est éloigné de 0.1 à 0.8 mm. du bord; un mois plus tard cette distance est de 1.0 à 1.3 millimètres.

10% des sardines de l'échantillon du 12 Mai appartiennent au groupe II dont la taille moyenne est de 18 cm. environ.

Poids.

Comme d'habitude, les sardines ont été pesées individuellement entières et vidées. Les valeurs moyennes pour les groupes de taille à chaque échantillon sont exposées au Tableau 12. Remarquer les chiffres élevés du 23 Avril.

Engraissement et nourriture.

La fréquence des divers stades des échelles empiriques d'engraissement viscéral et de replétion de l'estomac est donnée dans le Tableau 13. Il montre nettement que l'engraissement était tardif et que la nourriture a été abondante au cours de la période de nos observations.

Le contenu stomacal de quelques-unes des sardines a été pesé et analysé sommairement. Poids moyen 0.10 g. le 3 Mars, 0.40 g. le 28 Mars, 0.61 g. le 12 Mai, et 0.10 g. le 21 Juin.

Composition.

Date:	28/3	12/5	21/6
Eléments	%	%	%
Diatomées	5	5	4
Péridiniens	—	10	60
Noctiluques	—	15	—
Tintinnidés	—	5	
Copépodes	35	55	24
Larves de Crustacés	20	—	—
Gastéropodes larvaires	—	10	—
Œufs divers	—	—	12
Pollen de pin	40	—	—

Nous pensons que l'éclecticisme alimentaire de la sardine est déjà bien démontré et qu'il devient superflu d'y revenir.

Tableau 13. Fréquence (%) des stades d'engraissement viscéral et de réplétion stomacale.

Stades	Engraissement				Réplétion			
Date	I	II	III	IV	I	II	III	IV
21/2	100	—	—	—	50	48	2	—
3/3	100	—	—	—	17	42	35	6
28/3	100	—	—	—	7	35	43	15
23/4	93	7	—	—	—	17	53	30
12/5	21	79	—	—	10	39	28	23
21/6	—	96	4	—	3	52	27	18

Caractères sexuels.

Au total les femelles sont bien plus nombreuses que les mâles (382 et 249 respectivement), disproportion dérivant surtout de l'échantillon du 12 Mai. Leur taille moyenne est un peu plus grande (Tableau 14) que celle des mâles, fait déjà constaté.

L'observation empirique de la maturité (Tableau 14), ainsi que les valeurs moyennes du poids des gonades (Tableau 15) montrent que durant la période Février-Mai 1950, l'aire de pêche a été frequentée par des bandes de sardines à maturité avancée. L'échantillon du 21 Juin, par contre, venait de frayer. Mais, d'aprés les observations des années passées, on trouve encore en Juin sur les pêcheries, des bancs de sardines au stade V.

Le problème de la durée de la ponte et des lieux de fraie reste à étudier. Les pêches de plancton faites dans la Ria de Vigo en Mai-Juin 1950 ont été toujours négatives quant aux œufs et les larves de sardine.

Formule vertébrale.

Les résultats du dénombrement des vertèbres (Tableau 16) sont venus confirmer l'avis exprimé par nous l'an dernier (*Annales Biologiques*, Vol. VI). Le nombre moyen des vertèbres des sardines de la classe 1949 (51.35) excédait celui des classes précédentes, la différence étant de + 0.15 à + 0.20.

Tableau 14. Caractères sexuels.

Date		N	T[1])	Stades de maturité I	II	III	IV	V	VI	VII	Moy.
21/2	♂	43	152	1	—	2	3	10	19	8	5.6
—	♀	54	157	1	—	—	8	24	11	4	5.2
3/3	♂	55	147	—	—	5	36	13	1	—	4.2
—	♀	42	153	—	—	1	21	11	7	2	4.7
28/3	♂	58	145	—	—	15	33	9	1	—	3.9
—	♀	42	150	—	1	7	18	12	2	2	4.3
23/4	♂	34	153	—	2	2	16	10	3	1	4.4
—	♀	66	165	—	—	8	39	15	4	—	4.2
12/5	♂	44	158	—	1	1	12	19	8	3	4.9
—	♀	153	163	—	10	26	60	34	16	7	4.3
21/6	♂	15	156	4	7	3	1	—	—	—	2.1
—	♀	25[2])	157	3	21	1	—	—	—	—	19.9

[1]) Taille moyenne.
[2]) En plus, 60 individus à sexe imprécis.

Tableau 16. Formule vertébrale.

Date	50	51	52	53	N	M ± Fl	±σ
21/2	6	50	33	3	92	51.36 0.23	0.652
3/3	6	52	29	—	87	51.26 0.21	0.576
28/3	8	42	27	2	79	51.29 0.26	0.678
12/5	13	71	54	7	145	51.38 0.20	0.715
21/6	2	36	26	3	67	51.45 0.26	0.630
Total	35	251	169	15	470	51.35 0.10	0.663

M. Oliver et F. Navarro.

La Sardine de la Côte Est d'Espagne.

Le port de Castellon, sur la côte orientale d'Espagne, par 39°58′ N., est devenu au cours des dernières années un important port sardinier.

Tableau 15. Poids moyen des gonades, en grammes.

Date	Testicules						Date	Ovaires					
Taille	21/2	3/3	28/3	23/4	12/5	21/6	Taille	21/2	3/3	28/3	23/4	12/5	21/6
120	0.58				–	—	120	—		-			
125	—				–	—	125	0.95	—	—	-		–
130	0.84	0.52	0.26		–	—	130	0.14	0.41	0.51			—
135	0.82	0.60	0.56	—	1.30	—	135	0.53	—	0.66	—	—	—
140	1.15	0.86	0.80	—	0.99		140	1.20	1.02	0.80	—	0.65	—
145	1.82	1.00	0.71	0.88	1.14	—	145	1.70	1.23	0.80	—	0.74	—
150	1.33	1.25	0.59	1.27	2.04	0.17	150	1.03	1.22	0.80	1.08	0.92	0.54
155	2.03	1.06	0.60	1.36	1.51	0.09	155	1.79	1.21	0.96	1.07	1.09	0.16
160	2.32	1.41	0.53	1.20	1.54	0.18	160	2.63	2.17	0.99	1.13	1.11	0.17
165	2.02	1.66	1.15	1.33	1.73	0.13	165	2.18	3.03	1.89	1.44	1.49	—
170	1.99	1.63	—	1.81	1.96	—	170	3.20	3.00	3.02	1.44	1.52	0.19
175	2.66	—	—	—	2.04	—	175	3.07	—	1.21	1.57	2.23	—
180	2.05	—	—	—	3.11	—	180	2.57	2.12	—	2.78	2.53	—
185	—	—	—	—	2.53	—	185	—	—	—	—	3.55	—
190	—	-		-			190	—	—	—	—	3.34	—
195	—	—	—	—	—	-	195	4.24	—	—	—	2.73	—

La pêche de la sardine se fait pendant toute l'année sauf en Janvier, Février et parfois Mars à l'aide de filets tournants et coulissants («traîñas» et «mamparras»), le poisson étant attiré par la lumière de puissantes lampes à essence.

La pêche est interrompue à chaque pleine lune pendant huit jours.

Au cours de l'hiver, des petites quantités de sardines sont débarquées provenant de pêches au chalut, ou bien de pêches «au feu» aux alentours des îles Baléares occidentales.

Statistiques.

Les apports annuels, qui étaient de 700 tonnes en 1940, se sont élevés à près de 5,000 tonnes en 1948 avec une moyenne de 3,500 tonnes pour la période 1945—1949.

Les chiffres exposés au Tableau 17 totalisent le poisson débarqué provenant de la pêche «au feu»; la sardine y compte pour le 90%, le reste correspondant à des allaches, anchois, chinchards, bogues, maquereaux, etc.

Tableau 17. Pêche au feu.
Quantites débarquées au port de Castellon[1]).
(Tonnes).

Mois	1945	1946	1947	1948	1949	Moy.
Janv.	—	—	—	1.3	0.9	0.4
Févr.	—	—	—	1.0	0.6	0.3
Mars	129.7	107.2	84.8	25.9	29.9	75.5
Avril	452.6	142.9	472.4	217.6	344.5	326.0
Mai	446.8	606.3	540.6	392.9	373.2	471.9
Juin	178.1	732.3	596.7	424.5	430.2	472.4
Juil.	244.3	513.2	381.5	590.1	678.2	481.5
Août	220.4	661.6	210.7	378.8	277.4	349.8
Sept.	115.5	597.4	244.4	452.0	285.5	338.9
Oct.	292.6	378.4	92.9	815.2	475.3	410.9
Nov.	457.4	62.4	92.9	1123.0	666.0	480.3
Déc.	53.6	15.3	—	581.0	142.7	158.5
Total	2591.0	3817.0	2716.9	5003.3	3704.4	3566.4

[1]) La sardine y compte pour la 90% environ.

Répartition des tailles.

De Novembre 1949 à Mai 1950, vingt-un échantillons ont été étudiés. Ceux de la période Janvier-Mars représentent des pêches au chalut, excepté l'un d'eux provenant d'une pêche «au feu», près Formentera (Baléares). En tout, le matériel provient de l'aire limitée par la côte d'Espagne, le méridien 1°40′ E. et les parallèles 38°30′ et 40°30′N.

Taille.

La fréquence des tailles — mesurées au millimètre et rapportées au centimètre le plus proche — est exposée au Tableau 18. Pour l'ensemble, la taille modale et la moyenne sont coincidantes (14 cm.). Le mode accessoire de 80 mm. traduit la présence de très jeunes sardines mélangées à des jeunes anchois, pêchées en Mai tout près de la côte; le sommet placé en 200 mm. est produit par l'échantillon de Formentera (Février) où des grosses sardines apparurent parmi des bogues (prédominantes) et des chinchards.

Tableau 18. Fréquence des tailles.
(En pourcentage).

Taille mm.	1949 Nov.	Déc.	1950 Janv.	Févr.	Févr.[1]	Mars	Avr.	Mai	Total
70	—	—	—	—	—	—	—	2.6	0.4
80	—	—	—	—	—	—	—	18.1	3.0
90	—	—	—	—	—	—	—	10.6	1.7
100	—	—	—	—	—	—	—	1.6	0.3
110	2.3	25.9	—	—	—	—	8.4	0.3	3.3
120	18.5	50.0	0.9	0.5	—	—	34.8	5.6	13.5
130	19.9	15.5	13.6	17.9	—	3.4	31.3	15.2	16.5
140	18.3	6.9	22.1	36.9	—	33.9	16.4	12.2	19.1
150	15.4	—	28.2	34.0	—	37.9	7.0	17.8	18.5
160	14.4	1.7	24.9	7.3	—	17.8	1.5	12.9	11.9
170	8.0	—	6.1	1.7	—	6.9	0.5	2.3	4.2
180	3.1	—	3.7	1.7	2.0	—	—	0.3	1.6
190	—	—	0.5	—	15.4	—	—	0.3	0.9
200	—	—	—	—	60.8	—	—	—	3.2
210	—	—	—	—	17.5	—	—	—	0.9
220	—	—	—	—	4.1	—	—	—	0.2
N =	513	116	213	179	97	174	201	303	1,796
Moy. = (mm.)	140	121	150	144	201	149	128	124	139

[1]) Echantillon de Formentera (Baléares).

Au cours de ces études, nous avons eu l'occasion de constater le raccourcissement «*post-mortem*» que subissent les sardines. Les valeurs moyennes à partir de la première mensuration du poisson tout frais sont: 1.2 mm. depuis 6 heures; 1.9 depuis 12 heures; 2.7 depuis 18 heures et 3.2 après 24 heures. Ces chiffres sont valables pour des sardines de 13 à 16 cm.

Caractères sexuels.

Dans le matériel étudié (N = 1,403) le nombre des mâles surpasse celui des femelles: 52.2 et 44.8% respectivement; plus 3% d'individus à sexe imprécis. La prédominance des mâles est nette en Décembre (70.6%), Février (73%) et Mars (66%); par contre, la proportion est inverse en Novembre, Janvier, Avril et Mai. Les exemplaires à sexe indéterminé correspondent au printemps.

Les travaux d'Andreu (*Annales Biologiques*, Vol. VI, p. 64) sont valables quant à l'époque de frai et les circonstances de la ponte.

Tableau 19. Fréquence des groupes d'âge.

(En pourcentage).

	1949		1950						
Age	Nov.	Déc.	Janv.	Févr.	Févr.[1]	Mars	Avr.	Mai	Total
I	—	—	—	—	—	—	64.9	56.0	17.4
II	15.3	48.0	10.5	29.7	—	44.4	29.8	34.0	22.6
III	41.8	40.0	55.1	54.1	3.1	48.1	5.2	6.0	31.3
IV	30.0	12.0	32.7	16.6	12.5	7.4	—	4.0	17.9
V	11.7	—	1.7	—	56.0	—	—	—	8.2
VI	0.6	—	—	—	25.0	—	—	—	2.1
VII	—	—	—	—	—	—	—	—	—
VIII	—	—	—	—	3.1	—	—	—	0.2
N =	153	25	58	24	32	27	77	50	446

[1]) Echantillon de Formentera (Baléares).

Age et croissance.

La lecture des écailles est particulièrement difficile. Nous ne l'avons réussie que pour 446 sardines; soit 29% du matériel monté.

Le Tableau 19 donne la fréquence des groupes d'âge par mois et au total. On voit que le matériel est constitué par des sardines âgées d'une à huit années, les plus nombreuses étant celles des groupes II et III.

Les valeurs calculées pour L_1, L_2 etc... dans l'échantillon de sardines de Formentera sont les suivantes:

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
mm.	138	156	184	193	200	204	205	207
N =	33	33	33	32	26	10	1	1

Pour les autres échantillons, la croissance, déduite par combinaison des tailles réelles dans l'hiver et des valeurs calculées sur les écailles, est la suivante:

	l_1	l_2	l_3	l_4	l_5
mm.	113	138	149	154	163

B. Andreu, J. Rodriguez-Roda et
M. G. Larraneta.

La Sardine des Baléares en 1950.

Les études sur la Sardine, interrompus depuis Avril 1949, ont été repris par le Laboratoire de Palma de Mallorca en Août 1950.

Sardines de la classe 0.

Pendant l'année entière, des sardines de petite taille fréquentent les rivages de la baie, où elles sont pêchées à l'aide d'engins trainants littoraux. De même, la pêche au filet tournant au feu pratiquée en automne tout près de la côte, attire parfois des bancs de sardines mesurant 10 à 12 cm.

Nous avons étudié, du 24 Août au 10 Octobre, dix échantillons de cette provenance. La répartition mensuelle des tailles est indiquée ci-dessous en pourcentage.

cm.	6	7	8	9	10	11	12	N
Août.....	—	0.5	49.0	47.6	2.9	—	—	212
Sept.....	—	—	15.8	37.8	23.9	19.3	3.7	456
Oct.....	0.5	—	3.1	21.2	37.6	35.4	2.2	226

Aucun anneau d'hiver n'est présent sur les écailles de ces poissons. Nés au cours de l'hiver dernier, ils sont âgés de 8 à 10 mois; leur taille modale montre un accroissement d'un centimètre par mois. Tous sont immatures; cependant, dans l'échantillon du 10 Octobre, (taille moyenne de 108 mm.), les individus à sexe déjà discernable sont en majorité.

L'observation directe de la croissance de la sardine au cours de sa première année vaut certainement mieux que la méthode scalimétrique, aboutissant parfois à des résultats absurdes.

Sardines adultes.

Nous avons pu nous procurer deux petits échantillons (9 et 17 Novembre) provenant des pêches au feu au large d'Andraitx, sur la côte ouest de Majorque.

Dans ces échantillons, les tailles modales 15 et 18 cm. représentent les groupes d'âge I et II; la présence de sardines du groupe III n'est pas décelable d'après la fréquence des tailles.

Tailles, cm.	15	16	17	18	19	20
Nombre	20	11	21	23	18	7

La classification du matériel d'après les écailles a été faite avec beaucoup d'hésitation par l'observateur; cependant, il a signalé la présence de sardines des groupes 0, I, II et III.

Le tableau ci-dessous montre que la maturité sexuelle était très avancée le 17 Novembre:

	Stades (%)				
Date	II	III	IV	V	VI
9/11	16	60	18	6	—
17/11	—	14	38	42	6

A cette dernière date, les ovaires des sardines les plus grandes pesaient de 4 à 5.5 grammes.

La formule vertébrale établie en 1950 est à peu près celle obtenue les années précédentes

v	f	
50	8	N = 9
51	40	M = 51.51
52	41	Fl = $\pm$ 0.26
53	8	= $\pm$ 0.762

M. Oliver et F. Navarro.

La Reproduction de la Sardine (*Sardina pilchardus* Walb)., et de l'Anchois (*Engraulis encrasicholus* Lin.) de la Zone Côtière du Maroc, au cours de l'Année 1949.

Comme deux précédentes notes concernant les résultats de 1947 et 1948 celle-ci est basée sur l'analyse quantitative des œufs de sardines et d'anchois du plancton récolté en séries trimestrielles dans les eaux superficielles de la zone côtière du Maroc, entre Tanger et le Détroit Canarien.

De même qu'en 1947 et 1948 l'échantillonnage du plancton a été fait à chaque station avec un filet de 30 cm. de diamètre d'ouverture, tiré à une vitesse de 5 nœuds pendant 5 minutes.

I. Sardine (voir la Figure 11).

L'année 1949 présente des différences marquées avec les années 1947 et 1948.

Elle se caractérise de la manière suivante:

1. La ponte maxima en hiver, décroissante au printemps, s'achève en été, tandis que l'automne (arrière saison) marque le début d'une nouvelle ponte annuelle qui, fort probablement, aura son maximum en hiver 1950.

Rappelons qu'en 1947 et en 1948 la ponte débutait en hiver, passait par son maximum au printemps pour se terminer en été-automne.

2. En outre, la ponte de 1949 est beaucoup moins étroitement localisée que celles de 1947 et 1948. Alors qu'au cours de ces 2 dernières années elle se fractionnait en deux aires bien distinctes (une aire septentrionale et une aire méridionale) séparées par un secteur central (de Mazagan à Mogador) où l'on ne trouvait pas d'œufs de sardines, en 1949 la ponte s'échelonne tout le long de la zone côtière.

Bien que la densité des œufs soit moindre dans le secteur central, la solution de continuité si caractéristique de l'aire de ponte des sardines marocaines a disparu-tout au moins en hiver (période de ponte maxima) et en automne (période de reprise de la ponte).

Ces 2 anomalies trouvent leur explication dans les variations de la température de l'eau de mer.

Les eaux côtières du Maroc plus lentes à se refroidir à partir de l'automne 1948 ont été nettement plus chaudes en hiver 1949 qu'au cours des hivers précédents. Il en est résulté une plus grande précocité de la ponte.

La zone froide de Safi — moins froide pendant l'hiver 1949 (16°5—17°5) et moins développée — a permis à une partie des sardines adultes, les plus précoces, qui la peuplent de se reproduire in situ sans avoir à migrer vers les températures idéales (17°—19°) qu'elles ne trouvaient normalement que plus au nord (Casablanca) et plus au sud (Cap Ghir).

Un fait particulièrement intéressant est à signaler.

En hiver 1949, des œufs de sardines ont été récoltés en quantité importante à la station 5 de la ligne de Puerto-Cansado (29°04′ N. et 13°07′ W. Gr.) c'est-à-dire en pleine mer, plus près de la pointe septentrionale des Canaries

Figure 11.

Figure 12.

que du continent africain, au-dessus des fonds de 1500 m.

La présence d'œufs en cet endroit où la température de 18°—18°5 en surface est celle qui convient le mieux à la ponte de la sardine marocaine montre que cette espèce, essentiellement côtière, peut dans certains cas se déplacer vers la haute mer et s'y reproduire. Elle apporte un argument supplémentaire en faveur de l'hypothèse des migrations de grande amplitude que peut effectuer ce clupe.

II. Anchois (voir la Figure 12).

La reproduction de l'anchois tout en présentant le même aspect général qu'en 1947 et 1948 a subi presqu'aussi fortement que celle de la sardine l'influence des variations hydrologiques caractéristiques de l'année 1949.

La présence d'eaux anormalement chaudes (20°5) dans l'extrême sud marocain a déclenché une ponte rapide portée à son maximum au printemps, tandis que dans le secteur nord où la poussée des eaux chaudes a été plus tardive ce maximum ne s'est produit qu'en été.

Ces phénomènes traduisent l'étroite corrélation existant entre la reproduction des clupes marocains (donc la concentration des reproducteurs) et la situation hydrologique de cette zone atlantique.

Intéressante du point de vue œcologique elle ne l'est pas moins sur le plan pratique et a permis, en fait, de fournir une aide utile aux industries marocaines de la pêche.

Jean Furnestin et Marie-Louise Faure.

Sardinelle (*Sardinella aurita* L.).
La Sardinelle ou Allache des Baléares en 1950.

Nos observations dans la période Août-Décembre 1950 ont porté simultanément sur les adultes et sur les jeunes poissons de la classe 0. Les adultes sont pêchés surtout au filet tournant, parfois aux filets dérivants. Les lots de jeunes allaches proviennent des pêches au filet traînant, bouts en terre.

Taille et âge.

Les Tableaux 20 et 21 indiquent la répartition des tailles des adultes et des jeunes; (mensurations, faites au millimètre, et rapportées au centimètre le plus proche). La taille des adultes varie entre 16 et 26 cm; valeur moyenne environ 21.5 cm. normale.

La composition des bancs des petites allaches demeurant tout près du rivage, ainsi que leur croissance très rapide apparaissent nettement dans le Tableau 21. Les bancs sont

Tableau 20. Fréquence des tailles (%).

Date	2/8	23/8	7/9	20/9	18/10	3/11	Total
cm.							
16	—	2	—	—	—	—	0.3
17	—	20	2	—	2	2	3.7
18	3	22	2	—	4	4	5.4
19	6	34	6	—	12	8	10.3
20	25	16	24	8	20	6	17.7
21	16	6	50	18	16	8	18.6
22	15	—	12	30	32	38	20.3
23	16	—	4	24	14	22	13.7
24	16	—	—	14	—	10	8.0
25	3	—	—	4	—	2	1.7
26	—	—	—	2	—	—	0.3
N	100	50	50	50	50	50	350

Tableau 21. Classe 0: Fréquence des tailles (%).

Date / cm.	12/9	3/10	20/10	6/11	11/12
5	2	3	—	—	—
6	43	58	6	—	—
7	51	15	67	2	—
8	3	11	20	16	—
9	1	13	7	56	5
10	—	—	—	22	34
11	—	—	—	4	49
12	—	—	—	—	10
13	—	—	—	—	1
14	—	—	—	—	1
N =	97	101	99	68	96

homogènes à l'exception de quelques individus de 12 à 14 cm. appartenant peut-être à la classe I et nés de ponte tardive. La taille moyenne: 6.5 cm. en mi-Septembre, monte à 10.5 cm. quatre mois plus tard. La présence d'allaches mesurant 5 et 5.5 cm. a été constatée depuis le 24 Août. Le 15 Août, nous avions repéré des allaches de 9 à 14 cm., évidemment nées en 1940.

Tableau 22. Répartition d'après l'âge.

Classe / Age cm.	1949 I	1948 II	1947 III	1946 IV
17	6	—	—	—
18	11	—	—	—
19	24	4	—	—
20	24	21	1	—
21	5	23	3	—
22	8	27	13	—
23	3	25	13	1
24	1	5	20	1
25	—	2	4	—
26	—	—	1	—
N =	81	107	55	2

La lecture des écailles est malaisée, mais les résultats obtenus (Tableau 22) confirment les faits connus sur la croissance de la sardinelle. Le groupe 0 n'est pas représenté dans les pêcheries au large. Les poissons de notre groupe I (taille modale de 19—20 cm.), sont nés 13—17 mois auparavant. Le groupe II (taille modale de 22 cm.) est âgé de 25—29 mois et le groupe III (taille moyenne de 24.5 cm.) est âgé de 37—41 mois.

Les tailles pour l_1, l_2, l_3 n'ont pas été calculées, car le plus souvent les marques sur les écailles sont doubles et, à chaque couple, l'annéau intérieur correspond peut-être à la crise de fraie.

Tableau 23. Caractères sexuels.

Date	Mâles[1]) N	Mâles[1]) TM	Femelles N	Femelles TM	Maturité (%) II	III	IV	V	VI	VII
2/8	94	214	6	224	—	2	22	21	44	11
23/8	20	192	25	188	76	18	2	2	2	—
7/9	27	213	22	208	51	31	10	6	—	2
20/9	15	216	35	226	26	44	16	14	—	—
18/10	25	210	25	206	96	4	—	—	—	—
3/11	18	221	23	223	100	—	—	—	—	—

[1]) TM = Taille moyenne.

Tableau 24. Poids moyen des gonades (g.).

Testicules

Date / Taille	2/8	23/8	7/9	18/10	3/11
165	—	0.06	—	—	—
170	—	—	—	—	—
175	1.40	0.10	—	—	—
180	1.35	0.14	0.10	—	—
185	1.85	0.15	—	—	—
190	2.00	0.26	—	—	—
195	2.64	—	0.55	0.06	—
200	2.50	1.24	0.34	0.05	—
205	2.83	—	0.77	0.10	0.10
210	3.03	—	1.84	0.25	0.15
215	3.75	—	0.60	0.18	0.20
220	4.72	—	—	0.22	0.22
225	4.64	—	—	0.22	0.15
230	5.65	—	—	0.20	0.20
235	5.00	—	—	—	0.20
240	5.00	—	—	—	—
245	5.80	—			
250	9.00	—	—	—	—

Ovaires

Date / Taille	2/8	23/8	7/9	18/10	3/11
165	—	0.21	—	—	—
170	—	0.10	—	—	—
175	—	0.26	—	—	—
180	—	0.25	—	0.10	0.10
185	—	0.31	—	0.15	—
190	1.70	0.40	0.30	0.15	
195	—	0.65	0.25	0.17	0.10
200	—	1.30	0.30	0.30	—
205	—	2.04	1.76	0.20	—
210	—	1.65	0.54	0.29	0.30
215	—	—	1.27	0.37	0.25
220	4.85	—	0.90	0.57	0.32
225	13.50?	—	4.35	0.27	0.20
230	—	—	—	—	0.40
235	—	—	—	—	0.50
240	—	—	—	—	0.50
245	3.50	—	—	—	0.60
250	—	—		—	

Sexe et maturité.

Les caractères sexuels des échantillons sont résumés dans les Tableaux 23 et 24. La prédominance des mâles sur les femelles (59.4 et 40.6% respectivement) provient de l'énorme disproportion trouvée le 2 Août (94 mâles pour 6 femelles). C'est un fait déjà bien établi que les bancs de Clupéidés subissent à l'approche de la ponte un grand remaniement compor-

Tableau 25. Engraissement viscéral et réplétion stomacale.

Stades	Engraissement				Réplétion			
Date	I	II	III	IV	I	II	III	IV
2/8	98	2	—	—	12	37	28	23
23/8	2	80	14	4	20	58	18	4
7/9	20	54	16	10	4	58	30	8
20/9	52	46	2	—	32	60	8	—
18/10	4	34	44	18	—	48	44	8
3/11	2	58	30	10	—	38	50	12

tant l'isolement fugace des sexes. La ponte accomplie, la représentation des sexes dans les lots redevient normale.

La taille moyenne des allaches femelles n'est pas plus forte que celle des mâles contrairement à ce qui se passe chez la sardine.

Les chiffres concernant la fréquence des stades de maturité empirique, ainsi que le poids moyen des gonades, montrent une différence nette entre l'échantillon du 2 Août et les suivants. On peut dater vers mi-Août la fin de la période de ponte. Deux mois après, les produits sexuels non mûris dans la saison sont déjà réabsorbés, les gonades sont au repos et leur poids devient minime.

Engraissement viscéral et nourriture.

Dans le Tableau 25 sont résumées les observations empiriques sur ces caractères. Il montre que les poissons engraissent nettement aussitôt après la ponte. Les conditions d'alimentation, déficitaires pendant l'été, s'améliorent remarquablement en automne.

Tableau 26. Formule vertébrale.

Date	45	46	47	48	49	50	N	M ± Fl		± σ
2/8	3	9	19	46	21	1	99	47.77	0.34	1.013
23/8	–	1	10	28	11	–	50	47.98	0.34	0.707
7/9	–	2	9	16	23	–	50	48.06	0.39	0.814
20/9	–	–	13	26	11	–	50	47.96	0.33	0.691
18/10	–	2	23	20	5	–	50	47.56	0.35	0.725
3/11	–	–	9	32	9	–	50	48.00	0.29	0.600
Total	3	14	83	168	80	1	349	47.89	0.15	0.839

Formule vertébrale.

Les résultats exposés dans le Tableau 26 confirment le déclin continuel de la valeur moyenne, circonstance déjà signalée par nous (v. *Annales Biologiques*, Vol. VI). Depuis 1932, elle est tombée de 48.15 jusqu'à 47.89.

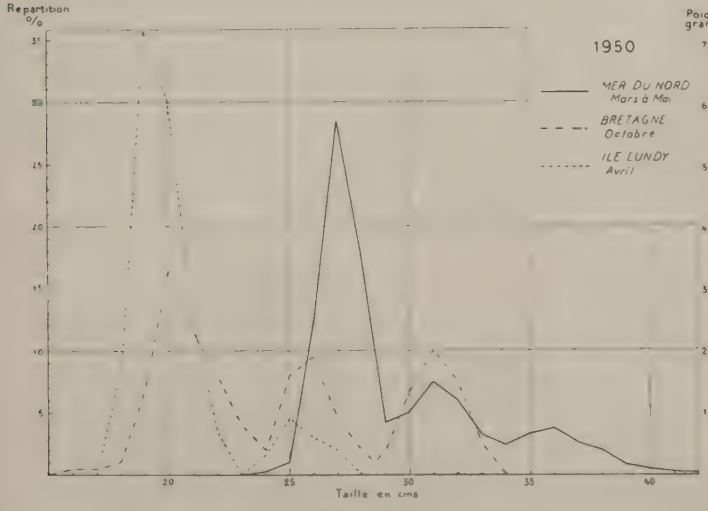
M. Oliver et F. Navarro.

SCOMBRIDÉS

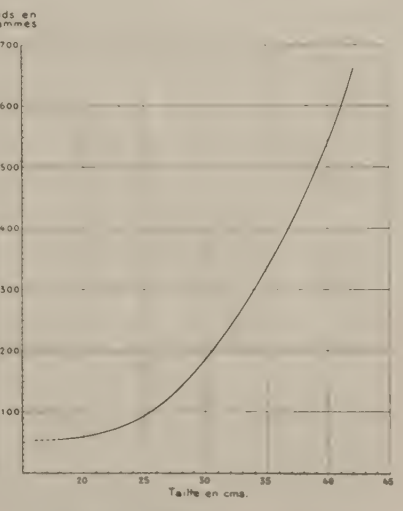
Maquereau (*Scomber scombrus* Linné).

Dans les ports de pêche français, les apports de maquereaux sont généralement évalués *au poids*, c'est-à-dire: d'après le nombre de poissons au kilogramme ou d'après leur nombre par «caisses d'origine» contenant ordinairement 25 Kg. de poissons.

Ces poissons étant triés d'après leur taille au moment de leur mise en caisses ou avant la vente au débarquement, cette indication permet de calculer le poids moyen d'un maquereau pour chacune de ces catégories commerciales.



Maquereau
Figure 13. Répartition d'après la Taille.



Maquereau
Figure 14. Corrélation Taille/Poids.

La corrélation Taille/Poids ainsi établie, a été vérifiée au cours de vingt années suivies d'observations régulières, par des mensurations faites sur des prélèvements fréquents complétées par la pesée des individus de même taille (longueur mesurée du bout du museau à l'extrémité de la queue, ramenée au centimètre inférieur, poids calculé au gramme près pour les individus isolés, à cinq grammes près pour les lots conséquents) et par le calcul du poids moyen pour chacune des tailles correspondantes.

Les résultats ainsi obtenus, détruits pendant la guerre, ont été reconstitués, complétés par de nouvelles observations (Nedelec-Le Gall) et ont permis d'établir la courbe représentative précédente. (Figure 4 et Tableau 27).

Tableau 27. Corrélation Taille/Poids.

Taille en cms	Poids moyen en g.	Nombre au Kg.	Taille en cm.	Poids moyen en g.	Nombre au Kg.
18	55	18 à 19	31	214	4.5 à 5
19	57	17 à 18	32	242	4
20	60	16—17	33	270	3.5 à 4
21	63	16	34	300	3 à 3.5
22	67	15	35	330	3
23	72	14	36	365	2.5 à 3
24	80	12—13	37	408	2.5
25	93	10—11	38	450	2 à 2.5
26	110	9—10	39	500	2
27	126	8	40	550	Vendus indi-
28	144	7	41	600	viduellement
29	165	6.5 (6–7)	42	665	au poids ou à
30	188	5.5 (5–6)	—	—	l'unité

Cette corrélation Taille/Poids, associée à celle de l'âge correspondant du poisson, nous a paru suffisamment précise pour distinguer les différents *groupes annuels* de maquereaux présents sur les lieux de rassemblements et de pêche de ce poisson lorsqu'il est trié au débarquement et vendu au poids d'après le nombre d'individus au kilo.

Golfe de Gascogne - Côte sud de Bretagne.

Entre l'embouchure de la Loire et la Pointe de Penmarch les groupes suivants ont été observés en 1950. (Voir Tableau 28).

Côte ouest du Finistère.

Sur la côte ouest du Finistère étaient capturés:

en Mai et Juin: des adultes des groupes III, IV et V et plus âgés, sur les frayères de l'espèce en Mer Celtique.

Tableau 28.

Mois	Groupe	cm.	Endroit	Engin
Mai.....	I	13 à 18	La Trinité	Lignes
	II	22 à 26	La Turballe	»
Juin.....	II	22 à 28	La Turballe	»
	III	30 à 34	La Turballe	»
Juil.....	II	22 à 27	La Turballe	»
	III	30 à 34	La Turballe	»
Août.....	I	16 à 19	Concarneau	»
	II	22 à 24	La Turballe	»
			Concarneau	»
Sept.....	II	20 à 26	La Turballe	»
Oct.....	I	17 à 22	Concarneau	Senne tournante
	II	22 à 29	Concarneau	
	III	29 à 33	Concarneau	

Mai-Juin: des immatures des groupes I (13 à 19 cm.); groupe II (20 à 24 cm.) capturés dans les baies et à proximité de terre.

Juillet-Octobre: toujours dans le voisinage de la côte, les mêmes groupes de maquereaux immatures (I et II) avec des maquereaux du groupe III (de 29 à 33 cm.) ayant frayé au cours de l'été.

Bretagne.

Origine: Concarneau.
Date: Octobre 1950.
Engin: Senne tournante.
Observateur: E. P. Priol.

Répartition

cm.	16	17	18	19	20	21	22	23	24
%	0.5	0.5	1.0	6.0	16.5	11.5	7.8	4.0	2.0
cm.	25	26	27	28	29	30	31	32	33
%	8.0	9.3	4.5	2.0	2.0	6.5	10.0	7.5	2.5

Trois modes correspondant à 3 classes distinctes:
Mode 20: Moyenne = 21.54; Long. moyenne = 22.04 cm.
Mode 26: Moyenne = 26.25; Long. moyenne = 26.75 cm.
Mode 31: Moyenne = 31.15; Long. moyenne = 31.65 cm.
(cf. Ann. Biol. 1949, p. 70).

Entrée sud de la Mer d'Irlande.

Origine: Trévose Ile Lundy.
Date: 10—15 Avril 1950.
Engin de pêche: chalut.
Observateur: Nedelec.

Répartition

cm.	17	18	19	20	21	22	23	24	25	26	27	28
%	0.1	7	36	30	12.4	3.4	—	1.5	4.5	3.0	2.1	—

N = 134.
Deux modes correspondant à deux classes distinctes.
Mode 19: Moyenne = 19.65; Long. moyenne = 20.17. Maquereaux à la fin de leur 2ème année d'existence.
Mode 25: Moyenne = 25.47; Long. moyenne = 26.07. Maquereaux à la fin de leur 3ème année d'existence.
Ponte en Mai: immatures.

Mer du Nord.

Pour comparaison, les résultats seront donnés ici, à la suite, des observations faites dans la partie septentrionale de la Mer du Nord sur une population géographique de maquereaux nettement distincte de celle de la Mer Celtique.

Origine: Utsire (Côte de Norvège).
Engin de pêche: chalut.
Observateur: NEDELEC.

I. *Date*: Mars 1950.

Répartition

cm.	24	25	26	27	28	29	30	31	32
%	0.2	1.4	18.9	34.9	20.1	4.3	5.2	4.6	5.6

cm.	33	34	35	36	37	38	39	40
%	1.6	0.9	1.0	0.6	0.3	0.1	0.1	0.1

N = 315.
Modes = 27 — 30 — 32; Moyenne = 28.10;
Long. moyenne = 28.60.

Le groupe II, à la fin de sa 2ème année d'existence, (mode 27) domine le groupe III (modes 30—32), qui apparait mal représenté.
Maturité sexuelle: Stades I—II de HJORT.

II. *Date*: Avril—Mai 1950.

Répartition

cm.	23	24	25	26	27	28	29	30	31	32	33	34
%	0.2	0.2	0.4	6.1	21.8	15.6	3.8	4.5	9.9	7.0	4.5	3.8

cm.	35	36	37	38	39	40	41	42
%	5.6	6.5	4.7	1.8	1.6	0.7	0.7	0.2

N = 443.
Mode: 27—31; Moyenne: 29.5 cm.; Taille moyenne: 30 cm.

Le groupe II domine encore (mode 27).
Le groupe III (mode 31) est plus net, de même que le groupe IV (mode 36).
Maturité sexuelle:

Début Avril:	Stades I et II: 56.2%	Stade V: 0
Fin Avril:	Stades I et II: 27.3%	Stade V: 0
Début Mai:	Stades I et II: 4.2%	Stade V: 37.5%

Pourcentage { Mâles .. 48.2%
Femelles 51.8%

J. LE GALL.

THONIDÉS

Le Germon (*Germo alalunga* GMELIN).

Examen du Nombre de Branchiospines.

Des observations portant sur le nombre de branchiospines ont été effectuées par R. LETACONNOUX en liaison avec M. MAUL du Musée de FUNCHAL sur des germons capturés entre les Açores, le Golfe de Gascogne et la côte nord d'Espagne en 1950.

154 germons ont été examinés.
Le nombre total de branchiospines varie de 25 à 32. Leur numération est plus difficile sur la partie supérieure de l'arc branchial où leur taille va en diminuant que sur la partie inférieure du même arc où la dernière épine est facile à discerner.

1. Partie supérieure de l'arc:

BR	N	
7.	5	Moyenne: 8.44
8.	80	
9.	64	Fl. = ± 0.166
10.	5	= ± 0.614

2. Partie inférieure de l'arc:

BR	N	
18.	2	Moyenne: 20.00
19.	23	Fl. = ± 0.190
20.	85	
21.	43	= ± 0.702
22.	1	

3. Nombre total de branchiospines:

BR	N	
26.	4	Moyenne: 28.56
27.	18	
28.	53	Fl. = ± 0.288
29.	49	
30.	26	= ± 1.063
31.	4	

Les résultats obtenus ont été comparés à ceux publiés avec GODSIL et BYERS sur les germons du Pacifique (Fish Bull. n° 60. California).

Arc branchial	Golfe de Gascogne	Madère	Pacifique
Partie supre.	8.44 ± 0.166	8.50 ± 0.163	8.77 ± 0.250
Partie infre.	20.11 ± 0.190	20.42 ± 0.260	20.13 ± 0.393
Total	28.56 ± 0.288	28.92 ± 0.334	28.90 ± 0.525

Ces résultats sont très voisins pour chaque lot d'individus examinés. Le caractère est assez variable, mais la valeur moyenne établie pour chaque lot est telle qu'on ne peut donner de significations raciales aux légères différences constatées.

R. LETACONNOUX.

Etude biologique d'après l'Examen des Ecailles.

Le 4 Juillet 1950, en Mer Tyrrhénienne, par L: 39°53′ N. et G: 13°04′ E. G., un germon ayant mordu aux lignes, fut amené à bord du «Président Théodore Tissier». Il mesurait 80.5 cm. et pesait près de 8 Kg.

Des écailles de l'animal furent examinées à sec, au binoculaire et sans préparation spéciale. Elles présentaient, nettement marqués, deux anneaux d'hiver (Fig. 15).

Figure 15.

1. Un premier point est ainsi à noter qu'en Méditerranée l'écaille du germon peut être utilisée pour la *determination de l'âge*. Il n'en est pas de même pour le germon de l'Atlantique dont les écailles sont, au dire des auteurs, difficilement lisibles. Il doit, en fait, en être bien ainsi puisqu'aucun des spécialistes qui ont étudié la croissance du germon n'a utilisé la méthode classique de lecture des écailles.

2. La forme de l'écaille, toutefois, ne permet pas le *calcul des tailles* correspondant aux divers âges, avec une grande précision. Les chiffres varient suivant le rayon vecteur considéré.

Les moyennes sont cependant acceptables, l'erreur pouvant être de l'ordre des variations individuelles normales.

Pour 12 séries de mesures effectuées sur 8 écailles provenant de différentes parties du corps nous avons trouvé les résultats suivants:

L. correspondant au 1er anneau (hiver 1848-49) . . 51.8 cm.
L. correspondant au 2ème anneau (hiver 1949-50) 73.3 cm.
Longueur au 1er Juillet 1950 . . . . . 80.5 cm.
l'animal étant né au cours de l'été 1947.

Il doit être noté que l'anneau correspondant au premier hiver ne marque pas en raison des petites dimensions de l'écaille à cette période.

3. De la comparaison du graphique de croissance du germon méditerranéen ainsi défini et du graphique correspondant du germon d'Atlantique établi d'après d'autres considérations, on peut conclure, les différences étant notables, qu'il s'agit de deux populations distinctes, la croissance étant plus rapide pour le sujet méditerranéen.

4. Ce point se trouve, au reste, être établi du fait même que les anneaux d'hiver s'inscrivent nettement dans un cas alors que, dans l'autre, on ne trouve pas d'écailles bien marquées.

5. Le fait connu que le *germon d'Atlantique est essentiellement migrateur*, se déplaçant avec les eaux où il se complaît, les suivant dans leurs retraits et dans leurs transgressions, explique l'absence, sur l'écaille, d'anneaux d'hiver marqués. Les variations saisonnières ne sauraient s'y inscrire puisqu'elles ne se produisent pas.

6. Le thon tyrrhénnien, au contraire, paraît subir les effets de telles variations. La rapidité de sa croissance se trouve saisonnièrement modifiée, ce qui se traduit, sur l'écaille, par la formation d'anneaux d'hiver caractérisés.

La netteté de ces anneaux établit que *le germon de Méditerranée est une race sédentaire.*

7. Une autre différence enfin, est à noter entre les deux populations, Méditerranée et Océan. En Atlantique (J. Le Gall), la première maturité sexuelle a lieu au cours de la 5ème année. Le germon de Mer Tyrrhénienne, à deux anneaux d'hiver, était une femelle œuvée. C'est donc, qu'en *Méditerranée, les sujets sont plus précoces*, pouvant être aptes à la reproduction dès la troisième année, si ce n'est plus tôt.

Henri Heldt.

Corrélation Taille/Fréquence des Germons en 1950.

Les mensurations de germons faites de Juin à Novembre 1950 soit au débarquement du poisson, soit à bord des thoniers ou du «Président Théodore Tissier» sur les lieux de pêche de ce poisson ont porté sur plus de 18,000 individus (mensurations faites par E. P. Priol, R. Letaconnoux, J. Morice, Ancellin et autres).

Les résultats obtenus dans l'interprétation des observations faites en 1950 confirment les précédents: — taille en centimètres de 45 cm.

à 115 cm. se répartissant autour de quatre classes modales nettement marquées

1950:	58	68	83	92
1949:	56	69	81	93

avec la représentation suivante établie mois par mois sur l'ensemble des mensurations faites de Juillet à Octobre 1950 (Figure 16 à comparer Figure 11, page 74 *Annales Biologiques* 1949).

Tableau 29. Répartition 1950 (‰).

Long. cm.	Juillet	Août	Sept.	Oct.	Totale
50— 54	1.2	2.5	7.0	5.2	4.0
55— 59	6.7	5.7	30.5	60.0	25.5
60— 64	11.1	6.8	12.0	42.6	19.4
65— 69	110.1	76.8	58.4	48.9	73.7
70— 74	30.6	24.3	23.7	18.0	25.1
75— 79	32.2	10.0	6.4	4.5	7.1
80— 84	25.5	46.1	34.5	8.3	28.0
85— 89	8.0	18.3	18.6	5.5	12.1
90— 94	0.1	7.5	6.9	1.7	3.8
95— 99	0.1	2.0	2.5	0.5	1.3
100—104	—	0.2	0.4	0.2	0.2
105—109	—	—	—	0.2	0.1
110—113	—	—	—	0.1	—

Ces quatre classes correspondent à nos quatre groupes II—III—IV—V—précédemment définis constitués par les germons nés au cours d'une même année groupe II : 1947 ; groupe III : 1946 ; groupe IV : 1945 ; groupe V : 1944.

Représentation mensuelle.

La proportion relative des germons appartenant à chacun de ces groupes est variable au cours de leur apparition dans le Golfe de Gascogne et en Mer Celtique.

Leur répartition mensuelle (Août-Sept.-Oct.) établie en 1949 montrait que :

(a) les germons du groupe II (taille modale 56) peu nombreux en Août apparaissent nettement plus nombreux en Septembre et en Octobre.

(b) les germons du groupe III (taille modale 69) abondants en Août diminuent en Septembre, mais restent presqu'aussi nombreux en Octobre.

(c) les germons du groupe IV (taille modale 81) relativement bien représentés restent aussi nombreux en Septembre et diminuent nettement en Octobre. (Cf. Tableau 13, Fig. 10, pp. 73, 75, *Annales Biologiques* 1949.)

La représentation proportionnelle mensuelle des germons sur les pêcheries au cours des mois d'Août, Septembre et Octobre 1950,

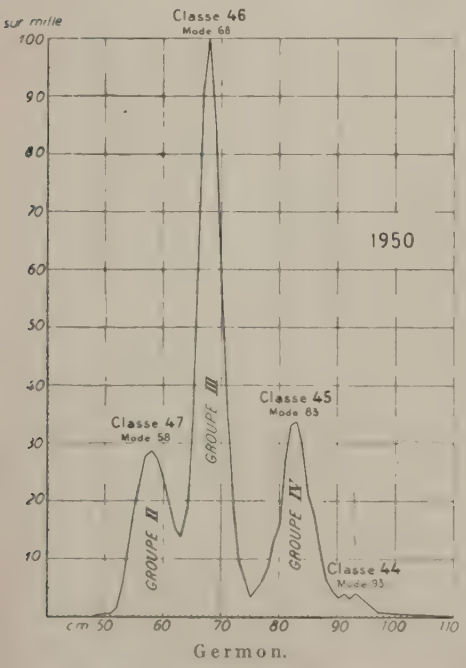


Figure 16. Répartition d'après la Taille pendant l'année 1950.

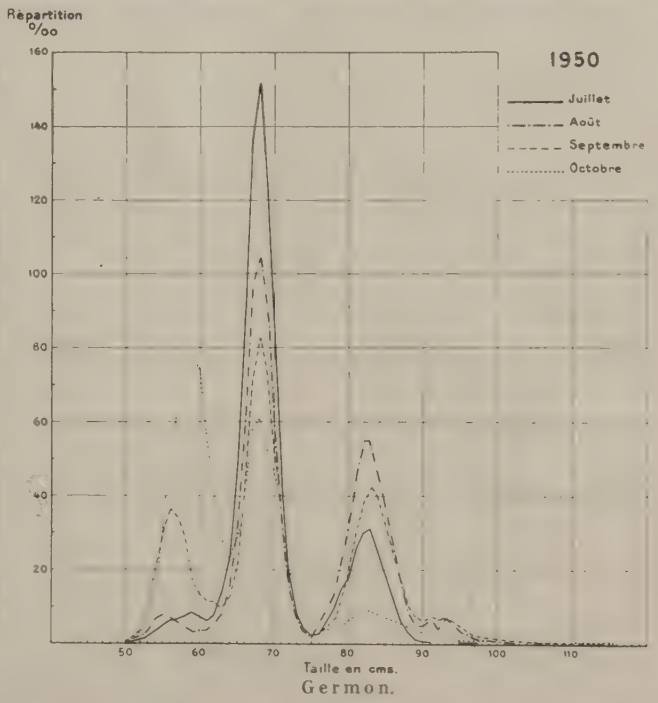


Figure 17. Fluctuation de la Taille en cours de la saison de pêche dans le Golfe de Gascogne.

(Tableau 29 et Fig. 17) confirme les faits déjà constatés en 1949 (1), (mais interprétés différemment à la suite d'une transposition erronée d'une colonne de résultats: p. 75, erreur rectifiée ci-dessus).

La représentation établie en 1950 pour le mois de Juillet montre que le *groupe II*, les plus petits parmi les germons, ne deviennent nombreux qu'à partir du mois de Septembre et sont relativement les plus nombreux en fin de saison,

— que le groupe III (germons de 62 à 74 cm.) domine déjà en Juillet et diminuera progressivement ensuite,

— que le groupe IV (germons de 75 à 89 cm.) assez bien représenté en Juillet, l'est mieux en Août, persiste jusqu'en Septembre pour disparaitre progressivement dès Octobre.

En somme, les petits germons du groupe II apparaissent surtout à la mi-saison (fin Août) venant remplacer ceux des groupes III et IV apparaissant dès le début de la saison: Juin-Juillet et disparaissant progressivement dès le début de Septembre.

Plus des trois quarts (77%) des germons capturés au nord du 40° Lat. appartenant à ces deux groupes III et IV, les résultats quantitatifs de la campagne dépendront de leur importance relative.

Or, au cours de la saison 1950, le groupe IV, Classe 1945 a été mal représentée et dès Septembre diminuait sensiblement sur les lieux de pêche, tandis que le groupe III très abondant en Juillet et Août diminuait en Septembre puis plus rapidement en Octobre, le départ de ces deux groupes n'était pas compensé par l'arrivée des germons du groupe II pourtant relativement plus abondants qu'en 1950.

Ceci explique, indépendamment des autres circonstances, les résultats observés dans les apports des thoniers en 1950 et leur chute brutale au cours du mois de Septembre après un bon début de saison.

Apports des Thoniers (en tonnes).

	1949	1950
Juin	4	6
Juillet	4,010	4,841
Août	3,775	4,078
Septembre	3,379	1,783
Octobre	2,427	1,752
Novembre	6	128
	13,601 T.	11,588 T.

J. LE GALL.

La Bonite à ventre rayé (*Katsuwonus pelamys* L.).

Ichthyométrie.

Des captures exceptionnellement importantes de bonites au ventre rayé (*Katsuwonus pelamys* LINNÉ 1758) ont été réalisées en Octobre 1950 et se sont prolongées jusqu'au début de Novembre, dans les parages de St-Jean-de-Luz, dans le fond du Golfe de Gascogne.

Les mensurations, faites au hasard au cours d'embarquement sur les bateaux de pêche, ainsi qu'au port de débarquement ou à l'arrivée du poisson dans les usines, n'ont pas eu la régularité voulue et n'ont pas porté sur un nombre d'individus suffisants (n = 109) pour que les résultats obtenus puissent être considérés comme représentatifs d'un «Type moyen» de l'espèce dans le fond du Golfe de Gascogne.

Ils ne sont donnés qu'à titre documentaire.

Katsuwonus pelamys L. Octobre 1950. Observateurs: E. P. PRIOL et autres.

Origine — Golfe de Gascogne (de Belle Isle à St-Jean-de-Luz).

Taille — De 42 cm. à 73 cm. avec mode 51. Un 2ème mode indécis à 65 cm.

Représentation approximative —

40 à 49 cm. 38%	60 à 69 cm. 7%
50 à 59 cm. 53%	70 à 79 cm. 2%

Caractères morphologiques —

Les mensurations ont été faites et les indices biométriques établis suivant la technique internationale recommandée.

Indice			Moyenne
T(i)	Indice céphalique: 100 Lcpl/L	27.2 à 27.8	27.6
D.I.i	Origine première dorsale: 100 D.I/L c.	32.0 à 32.3	32.17
D.2.i	Origine deuxième dorsale: 100 D.2/L c	59.6 à 60.4	60.18
V.i	Origine ventrale: 100V/L c	31.0 à 31.7	31.4
A. i	Origine anale: 100 A/L c	64.0 à 65.4	64.8
H. i	Corrélation Hauteur/Taille: 100 H/L c	22.4 à 23.2	22.86
pi	Longueur pectorale: 100 p/L c	13.0 à 14.6	13.17
Or.	Diamètre orbite: 100 O/Lcpl	14.6 à 16.2	15.5
I. Or.	Interorbitraire: 100 I.O/Lcpl	33.0 à 34.0	33.7

Caractères numériques	1° D.	2° D.	Pinnules
1ère, 2 ème dorsales et pinnules dorsales	XV (14.89)	+ 12 (11.54)	+ VIII (8.64)
	An.	Pin. An.	
Anale et pinnules anales	XIII (12.89)	+ VII (7.86)	

J. LE GALL.

Northern North Sea.

REVIEW

Once again it proved possible for only the Scottish research vessels to maintain a general survey of the Northern North Sea throughout the year, in association with their investigations in the Faroe-Shetland Channel and to the north-west. Other vessels have, however, operated in the area from time to time and, as in the past, there has been the most valuable cooperation between different laboratories by exchanges of material and information, by the organisation of drift-bottle returns and returns of marked fish, and in many other ways.

Comparative experiments with fishing gear etc. have been made during the year, using both the echometer as a means of indirect observations and, for the first time, underwater photography, both for gear observation and observation of marine life, including tagged herrings after their release.

Herring investigations are reported elsewhere in this volume but reference may be made here to the results which have already been obtained regarding migrations of herring between the north-eastern British coasts and the Continent.

Another development (reported to the Council in October, 1950, and to be published elsewhere later) concerns the correlation found between the numbers of two-year-old haddock entering the commercial stocks in the Northern North Sea and the dominant winds blowing over the area during the time when these fish may be expected to have been spawned and developing as larvae. Extending over a period of twenty-five years, this correlation suggests that valuable results may, in due course, be obtained by comparing fluctuations in other stocks with those of the dominant meteorological (and consequently oceanographical) conditions.

Observations of the Scottish lobster stocks on the north-east and north coasts have been continued, and a local programme of bottom fauna observations has been begun, from which it is hoped in due course to be able to establish standards by which annual fluctuations may be assessed.

The records of "rare" fish being caught in and nearby the area continue to be maintained, an interesting example being that of the sequence of records during 1949—50 of Ray's Bream *(Brama raii)* around the Scottish coasts.

Most of the reports which follow are based on data collected by the larger Scottish research vessels, and brief notes of their cruises are given below. The associated operations of the smaller vessels "Clupea" and "Kathleen" extended over the whole of the Scottish east and north coasts.

Month	Area "Scotia"	Area "Explorer"
II	N. W. North Sea	Central North Sea
II/III	Faroe-Shetl. Channel	N. W. North Sea
III/IV	Faroe. W. Orkney. Shetl.	Off W. coast of Scotland
IV/V	— —	N. W. North Sea
V	Faroe. Far.-Shetl. Channel	—
V/VI	— —	N. North Sea
VI	Faroe. Far.-Shetl. Channel	—
VII	N.-central North Sea	—
VII/VIII	Central North Sea	Faroe survey
VIII/IX	Faroe-Shetl. Channel	Off W. coast of Scotland
IX/X	— —	N. W. North Sea
X	Faroe survey	Central North Sea
X/XI	Faroe-Shetl. Channel	—
XI	— -	N. W. North Sea

A. Environment.

Observations show that 1950 was a year of relatively poor oceanic influence in the Northern North-Sea. The current flowing through the Faroe-Shetland Channel in March appeared to affect only the more northern reaches of the area, and rather more the eastern than the western region. This comparatively weak maximum was followed by a recession during the summer and it revived only weakly in the autumn, to judge both by temperature and salinity observations and the returns of drift-bottles.

The continuous plankton records obtained by the Oceanographic Laboratory at Leith have been developed further during the year and now provide information not only from the North Sea but from a wide range of waters influencing it, as is well shown by the successive records, for example, of both Tomopteris and of Thaliacea, recorded as spreading from the Atlantic into the area at a depth of ten metres. The Marine Laboratory records show that the relatively sparse samples of *Salpa fusiformis* recorded in 1949, for the first time in several years, were followed in 1950 by much larger numbers. Calanus appears to have been unusually abundant in the area during 1950.

The records of the occurrence of rare exotic species of plankton which have been provided in recent years will no longer be published in detail but the significance of the collected records will be reviewed from time to time.

B. The Fish.

Haddock. Detailed analyses of both commercial statistics and research vessel samples show that the 1945 and 1947 broods provided the main weight of the stock in 1950, whereas the 1946 brood appears to be almost negligible in the commercial fishery. The 1950 year-class would appear to be somewhat better than those of 1946 and 1947, but distinctly inferior to those of 1948 and 1949. Scottish records suggest that there has been little change in the overall catch per 100 hours' fishing from that in 1949.

Whiting. Preliminary statistics for the whiting stock are presented in a similar form to those for the haddock stock. There appear to be a number of similarities in the brood fluctuations of these two fish.

Flatfish. Statistics are given for the plaice stock conditions in several of the bays along the Scottish east coast. The lemon sole stock now includes considerable numbers of young fish (chiefly 1945 and 1946 broods).

Pelagic fish statistics will be given in the reports of the Herring Committee.

C. E. Lucas.

ENVIRONMENT

Hydrography.

Embracing the same sea regions as in 1949, namely, from Iceland to the west and north of Scotland, and the North Sea from latitude 61° N. to the Dogger Bank, the operations of the Scottish research vessels during 1950 were of a similar overall intensity to those of the previous year, with, however, some differences in the regional distribution of observations. More attention, for instance, was given to the Faroe-Shetland Channel and the Faroe shelf in 1950. The first was concerned with achieving quantitative definition of the strength of the North Atlantic Drift Current as this enters the region over the Wyville Thomson Ridge, and as it passes north-eastward along the Channel into the Norwegian Sea and in part into the Northern North Sea. Concentration of attention on the Faroe shelf region was concerned more immediately with biological problems.

As a special hydrographic investigation, surface to bottom temperature and salinity observations were repeated as frequently as possible throughout the year at certain selected positions in the north-western North Sea, to further, in the first instance, the investigation begun in and for earlier years, of the application to the sea, in possible biological connections, of the meteorological concept of accumulated temperature.

From January to November inclusive, 860 hydrographic stations were occupied, and some 7000 combined temperature-salinity observations taken. Oxygen and phosphate determinations, to the numbers of 1475 and 1377 respectively, were made in respect of surface and sub-surface levels at 280 of the above 860 stations. Preliminary estimations of hydrogen-ion concentration were made at a number of North Sea positions, using a pH metre with special adaptations to meet the relatively rigorous conditions of a ship's, as opposed to a shore, laboratory.

The liberation of surface drift-bottles in groups of five from 338 positions over the above-mentioned regions, and the regular output of drift-bottles at and *en route* to the Atlantic Weather Station I (latitude 59°N., longitude 19° W.) was continued throughout the year. In addition, from the beginning of May 1950, a similar scheme of liberations was carried out in respect of Weather Station J (latitude 52°N., longitude 20° W.), part of which operation was performed by the good offices of the Netherlands' meteorological authorities.

Table 1 summarises the results of the year's drift-bottle liberations as a whole, with the corresponding data for 1949 and 1948 included for comparison. The recoveries are subdivided according to the following coastal and other regions:

0′ = France.
0 = Ireland and W. England.
1 = The Outer Hebrides and W. coast of Scotland.
2 = N. coast of Scotland and W. coasts of Orkney and Shetland.
3 = E. coasts of Orkney and Shetland.
4 = Moray Firth shores between Duncansby Head and Rattray Head.
5 = E. Scottish coast between Rattray Head and St. Abb's Head.
6 = St. Abb's Head to intersection of latitude 54°N. with Yorkshire coast.
7 = English coast S. of latitude 54°N.
8 = Coasts between Texel Island and mouth of River Elbe, Germany.
9 = Coasts between mouth of River Elbe and Blaavandshuk, Denmark.
10 = W. Danish coast between Blaavandshuk and Hanstholm.
11 = Skagerak and Kattegat shores E. of line joining Hanstholm and Lindesnes.
12 = S.W., Norwegian coast between Lindesnes and latitude 62°N.

Table 1. Scottish Drift-Bottle Liberations, 1948, 1949 and 1950.

Liberations (L)		Recoveries (R) Frequency-Distribution																				
Year	No. of Drifters	0′	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals	$\frac{R}{L}$ %
1948	1550	—	—	6	21	17	18	1	—	—	—	6	19	104	38	109	3	2	1	—	345	22
1949	2710	—	—	30	32	20	2	—	—	—	—	17	33	110	47	149	34	1	3	3	481	18
1950	2765	1	40	44	26	19	3	2	1	—	—	—	2	13	38	63	4	1	5	3	265	9½

Table 2. North Sea Drift-Bottle Liberations.

Liberations (L)		Recoveries (R) Frequency-Distribution															$\frac{R}{L}$ %
Year	No. of Drifters	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Totals	
1948	910	4	6	14	1	—	—	—	6	15	89	30	44	—	2	211	23
1949	1095	1	1	—	—	—	—	—	12	30	108	36	55	14	—	257	23½
1950	680	1	9	1	2	1	—	—	—	2	13	31	34	—	1	95	14

13 = Norwegian coast between latitudes 62° N. and 70° N.
14 = Norwegian coast N. of latitude 70° N.
15 = At sea.
16 = The Faroe Islands.
17 = Iceland.

The small total percentage return from the 1950 liberations is conspicuous, as are also the relatively small returns from west Danish, Skagerak, Kattegat and the more northerly Norwegian coasts beyond the North Sea. From the intermediate (North-Sea) sectionof the Norwegian coast, on the other hand, returns in 1950 were very much on a par with those of the previous two years.

The significance of west Danish, and more especially Schleswig-Holstein, coast recoveries in 1948 and 1949 has been mentioned in former reports, (see *Annales Biologiques* V (1948), and VI (1949). The latter category, i. e., Schleswig-Holstein strandings, are entirely unrepresented among the 1950 returns, while west Danish coast recoveries between Blaavandshuk and Hanstholm number only two. The latter came from North Sea liberations, whereas, as can be seen by comparing corresponding entries in Tables 1 and 2, a small proportion of such recoveries in 1948 and 1949 originated outwith the North Sea. The same applies to the 13 Skagerak recoveries of 1950 which derived from all four quadrants of the North Sea north of the Dogger Bank, and embraced the period between April and October, with only very slight evidence of concentration in the last month of the period as was characteristic of this class of return in each of the two previous years.

North Sea Norwegian coast strandings, in 1950, on the other hand, included, as in the two years preceding, a small proportion of extra-North Sea derivatives, from the Faroe-Shetland Channel liberations of March, May, and September. These were recovered between mid-August and mid-November. Clearer evidence of a time-concentration among this category of recoveries is borne by the 31 returns from North Sea liberations. The liberations, in all four quadrants of the North Sea, as above, were made in all months from February to October inclusive. More than one-third of the recoveries therefrom, on the North Sea section of the Norwegian coast, occurred in the month of October and included drifters liberated within short distances of the coast as early as the month of May.

On the other side of the North Sea, Tables 1 and 2 indicate more southerly British east-coast recoveries in 1950 than in either 1948 or 1949. Two of these, on closer examination, prove to be of only local significance, but indicative, nevertheless, of conditions off the mid-east Scottish coast in April-May, 1950, which were of familiar and almost constant occurrence in the decade prior to the war, but for which no evidence from drift-bottle records has since been forthcoming. There is no doubt in these two months at least in 1950, of the functioning of the Mid-East Scottish Coast Eddy.

The third British east-coast return, from the north-east coast of England early in November, is, by its minimum average drift-speed of the order of 9 miles per day, as by the locus of the recovery in relation to its starting-point, to be linked with other similar pointers among the records to a moderate, but probably short-lived strengthening, in October 1950, of the oceanic incursion into the northern North Sea from the

Table 3. Faroe-Shetland Channel Region Liberations.

Liberations		Recoveries Frequency-Distribution																	$\frac{R}{L}$ %
Year	No. of Drifters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals	
1948	385	1	14	11	4	—	—	—	—	—	3	10	5	30	1	—	1	—	80	21
1949	655	3	14	13	1	—	—	—	—	5	2	1	6	49	9	—	—	1	104	16
1950	660	—	18	7	2	—	—	—	—	—	—	—	7	20	3	—	5	—	62	9

Table 4. Weather Station I.

Year	Liberations No. of Drifters	Recoveries Frequency-Distribution 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals	R/L %
1948	300	5	4	—	—	—	—	—	—	—	—	3	1	36	2	—	—	—	51	17
1949	690	27	16	6	1	—	—	—	—	—	1	1	4	26	9	—	1	1	93	13½
1950	740	36	5	2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	44	6

north and west. This incursion, as one and also two years before, apparently affected more the eastern half of the northern North Sea than the western part in which, one month later, evidence was forthcoming of a tendency to reversal of the normal southerly drift-current off the western North Sea seaboard.

Touching further on this matter of oceanic influence in the northern North Sea, it is to be observed that two of the three Moray Firth returns in 1950 and ten of the nineteen east Shetland and Orkney recoveries originated beyond the North Sea. Table 3, giving the results of the Faroe-Shetland Channel liberations, shows the regional origin of the above two Moray Firth returns and of seven of the ten east Shetland and Orkney recoveries from outwith the North Sea. Beyond these facts there is nothing remarkable to note in respect of these drifters which entered the North Sea from the Faroe-Shetland Channel, except perhaps the general impression that only very moderate rates of drift appear to have been involved, arguing only moderate intensity in the connecting link of the North Atlantic Drift Current.

Table 4 gives the results of liberations out to the Weather Station I in the two years and two months (November and December, 1948) during which these liberations have been made. The preponderance of returns from the west coasts of Scotland is clear, especially in 1950. By contrast, the complete lack of returns from northern Norwegian latitudes beyond the North Sea in 1950 is surprising, particularly in view of the results from Faroe-Shetland Channel liberations. In conjunction with the results in respect of liberations westward of Ireland to Weather Station J (Table 5), the indication is strong that, for the most part of 1950, the surface water drift west of the British Isles was mainly easterly—in fact, by the single French recovery and some of those in the south-west of England, somewhat south of east. It is not improbable that in such circumstances the intensity of flow of oceanic water through the Faroe-Shetland Channel was relatively weak, as seems to be indicated by the results so far considered. Estimates of surface drift-current velocities from drift-bottle records indicate maximal drift-speeds in the North Atlantic Drift Current through the Faroe-Shetland Channel of only about 9 miles per day between about mid-February and mid-March, as against the usual spring expectation of speeds of from 12 to 14 miles per day. From April to July at least drift-speeds of the order of only 6—7 miles per day seem to have been the rule, with considerable eddying in the north-western part of the North Sea. Drift-speeds rose again slowly from about the end of August to maxima of again around 9 miles per day in October, to fall away once more towards the end of the year.

These circumstances would appear to be borne out by the changing temperature-salinity distribution of the northern North Sea and the Faroe-Shetland Channel during 1950. In passing it may be recalled that the later drift-bottle results of 1949 liberations led to the deduction that "the oceanic influence in the northern North Sea and off the Norwegian coast northward therefrom reached a minimum in the last month probably of 1949 and thereafter revived again to a crescendo in March 1950", which is just the indication given by the earlier 1950 results.

In mid-February in the Shetland area, temperatures of 8°C. to 8.3°C. were positively anomalous to the extent of nearly 2°C., while

Table 5. Weather Station J.

Year	Liberations No. of Drifters	Recoveries Frequency-Distribution 0′	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals	R/L %
1950	420	1	40	8	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	50	12

salinity of 35.27 ‰ to 35.29 ‰ was higher than normal by about 0.05 ‰. These high anomalies, however, in the north and north-west North Sea declined southwards to positive temperature anomaly of only 0.5°C. and only very slight positive salinity anomaly in the central North Sea region.

By mid-March salinity had increased to 35.37 ‰ in the northern entrance to the North Sea.

By the month of May surface temperature anomaly over the whole northern North Sea region was practically zero and salinity anomaly distinctly negative. Temperature and salinity distributions throughout the summer in the northern and central North Sea were indicative of waning oceanic influence in these parts.

Salinity showed a tendency towards positive anomaly in the northern part of the central North Sea in October, but temperature on the other hand remained negative to the extent of 1° to 1.5°C. Similar slight positive salinity anomaly, with average temperatures, characterised the more open seas east of Shetland in November, but nearer Shetland negative salinity anomaly obtained.

To sum up, 1950 was clearly a year of relatively poor oceanic influence in the northern North Sea. A weak spring current through the Faroe-Shetland Channel in March really affected only the northern reaches of the North Sea, and rather in the eastern than the western half of the region. The intensity of the incursion tended slowly to retract during the summer and revived only weakly in the autumn.

Westward of the British Isles to longitude 20° W. there was apparent a bifurcation, approximately along latitude 55°N., in the eastward tending surface current from the North-Eastern Atlantic Ocean. Southwards from this latitude a southerly component gradually intervened, while the opposite occurred northwards from latitude 55°N. By the evidence available these directions would appear to have contained stronger east and south components during 1950 than are generally the rule.

J. B. Tait.

Plankton.

The Continuous Plankton Recorder Survey; the Plankton round the North of the British Isles in 1950.

In April, 1950, the Recorder Survey was transferred from University College, Hull, to the Scottish Marine Biological Association. The programme of work remained as before and the routes[1]) available for Recorder tows are shown in Figure 1. The additional routes "J" and "T" were made possible through the co-operation of the Geophysical Institute, Bergen, and the Royal Netherlands Meteorological Institute who arranged for the Norwegian and Dutch Weather Ships of P.I.C.A.O. to tow the Recorder to and from their stations.

These notes are in continuation of those included in *Annales Biologiques* V and VI (N.N.S. Ctee.) for 1948 and 1949; the arrangement is the same as in the two previous years except that the "T" route which runs northwards from Bergen has been included in each set of histograms. Unfortunately the "V" route from Pentland Firth towards Iceland was only available for three months but in 1951 a full series of tows can be expected. It should be stressed again that the histograms are intended as broad summaries only. The mean monthly density of the zooplankton is calculated from the theoretical volume of water which passes through the Recorder: the area of the aperture in the nose of the machine multiplied by the distance it was towed on the particular route in any month. Although an average figure is given it is not suggested that there were no variations in density of plankton along the route; in fact such variations were often considerable. All the samples were taken at a single depth, 10 metres, and no allowance has been made for vertical migration.

Figure 2 gives a very gross estimate of the quantity of phytoplankton caught. As explained earlier, these histograms show the proportion of the tows, or of the ten mile units of sampling in each month, which were coloured to

[1]) When sailing schedules permitted a record was taken on each route every month. Further details of the plankton taken are available from the Oceanographic Laboratory, 23 Sandport Street, Leith, Edinburgh, 6.

various degrees of "greenness", assessed against an arbitrary colour scale. It was hoped, possibly over optimistically, that by this method a rough idea of the chlorophyll content could be obtained. The first impression gained by comparing the 1950 histograms with those for 1948 and 1949 is that 1950 was a poor year for phytoplankton but a more detailed consideration of the individual samples suggests that this is not entirely true. The numbers of the commoner diatoms, *Rhizosolenia alata*, Thalassiosira spp. and Thalassiothrix spp. were not greatly less than in the earlier years. The apparent difference in the extent of colour more probably lies in the absence of a type of scum which was a feature of the Atlantic records in the summers of 1948 and 1949. We have no good idea about the origin or the composition of this scum because, quite apart from the unsuitability of the Recorder material for such a study, insufficient attention was given to it while we still had fresh samples. However, its presence may well have increased the quantity of smaller cells retained

Figure 1.

Fig. 1. A chart showing the routes along which the Continuous Plankton Recorder was usually towed monthly during 1950. The routes indicated by the heavier line, i.e., W, X, T, A, and K, are those selected for this summary while those indicated by a broken line, i.e., J, V, and M, were only available for part of the year. The dotted line marks the position of the 200-fathom contour.

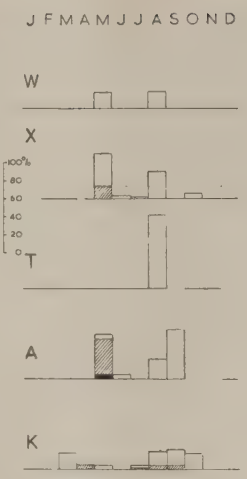


Figure 2.

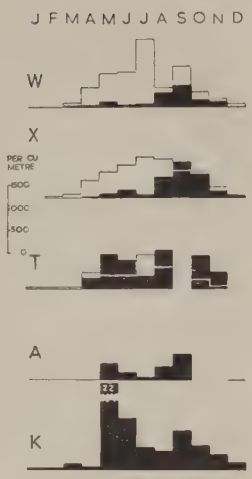


Figure 3.

Fig. 2. An estimate of the density of *Phytoplankton* month by month on the Recorder routes, W, X, T, A, and K. The histograms show the percentage of the route which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale. The open part of the histogram represents "pale green", the hatched part "green" and the blacked part "dark green". A gap in the base line indicates that no data were available in the particular month.

Fig. 3. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder routes, W, X, T, A, and K. The values represent the number of copepods per cubic metre either for the whole length of tow on lines A and K (black) or for the two parts of the tow which lie on either side of the 200-fathom contour on lines W, X and T, when the solid black histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water. A gap in the base line indicates that no data were available in the particular month.

by the 60 mesh silk and so have added to the green colouration. This scum was often associated with the presence of dinoflagellates which were far less abundant in 1950 than previously. The occurrence of "green samples" on the North Sea routes agreed well with the results of the two previous years.

Figure 3 shows total figures for all species of copepods combined. It confirms the belief obtained in the two previous years that, over the deeper Atlantic waters (shown in black), August-September is the most successful period for the copepods as a whole, although the very large numbers of Acartia found on "W" and "X" in the earlier years did not recur. In the North Sea (black), on "K" route, largest numbers were found in the spring and again, as before, the coastal Atlantic water (open histogram)

showed a compromise between the North Sea and deeper Atlantic.

The results for Calanus (Figs. 4 and 5) agree well with those found in 1948 and 1949, with the main difference that 1950 was a particularly good year for the species in the North Sea, higher numbers being found there than ever before in the Recorder survey. It is interesting that high numbers extended to the parts of the "T" records that were over the deep water because in the previous years on the "W" and "X" routes the denser concentrations were restricted to the relatively shallow coastal waters and, indeed, this was again the case in 1950; (note that the open histogram in Fig. 4 showing the average density of Stages V and VI to the coastal side of the 200 fathom contour are plotted at a quarter of the scale of the others). In 1950 there was, for the first time, some suggestion of subsidiary breeding periods over the deep Atlantic water after the main concentration in April and May; in the previous two years there was no indication of this. In the Atlantic coastal water three distinct generations were well defined.

Both Pleuromamma spp. and Euchaeta spp.

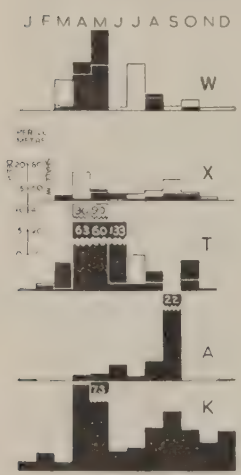


Figure 4.

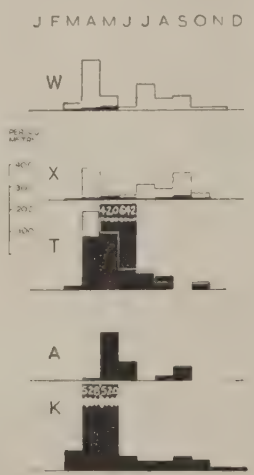


Figure 5.

Fig. 4. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder routes, W, X, T, A, and K. Details as in Fig. 3. Note different scales for solid (deep water) histograms and open (shallow water) histograms on lines W, X, and T. The scale for A and K corresponds with that for the solid (deep) histograms.

Fig. 5. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month on Recorder routes, W, X, T, A, and K. Details as in Fig. 3.

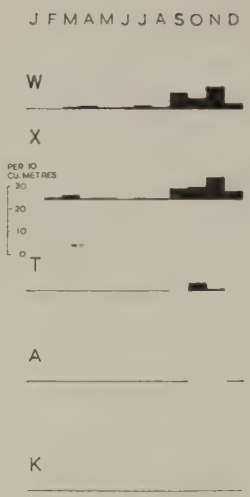


Figure 6.

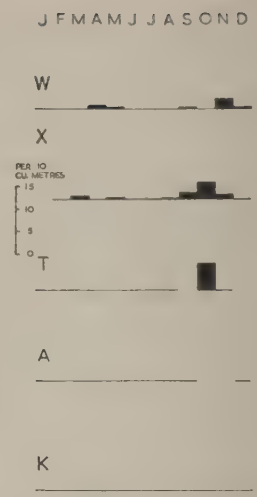


Figure 7.

Fig. 6. Histograms representing the relative numbers of *Pleuromamma spp.* taken month by month on Recorder routes, W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T. The majority of the copepods are *P. robusta* though a certain number of *P. abdominalis* and *P. gracilis* are included.

Fig. 7. Histograms representing the relative numbers of *Euchaeta spp.* taken month by month from the Recorder routes, W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T. By far the majority of the copepods are *E. norvegica* although a few *E. acuta* and *E. hebes* are included.

(Figs. 6 and 7) were restricted to the Atlantic routes and only occurred in any appreciable numbers in the latter part of the year. Both appeared only in one month on "T", in October, when they were found together.

In the earlier work, when data were only available from North Sea routes, it appeared that both Candacia and Metridia (Figs. 8 and 9) behaved in a similar manner and could both be considered as indicators of water movement into the North Sea from the northwest[1]). It is now clear, however that, outside the North Sea, on the Atlantic routes, their habitats are quite different. Whereas Metridia is common over the deeper water, Candacia is mainly restricted to the coastal side of the 200 fathom contour. In this series of summaries, for the sake of consistency, the average numbers of copepods over the deeper part of the Atlantic records have been compared with those on the North Sea lines, but we now

[1]) *Hull Bulletin of Marine Ecology*, Volume II, No. 14.

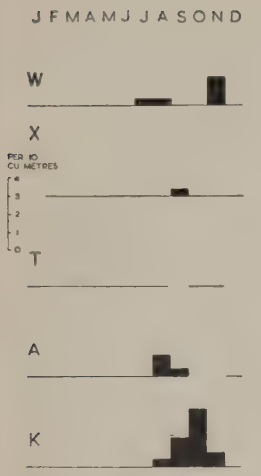


Figure 8.

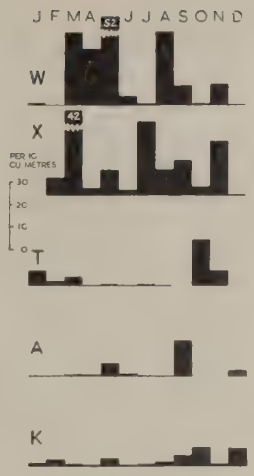


Figure 9.

Fig. 8. Histograms representing the relative numbers of *Candacia armata* taken month by month on the Recorder routes W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T.

Fig. 9. Histograms representing the relative numbers of *Metridia lucens* taken month by month from the Recorder routes, W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T.

realise that this is misleading in the case of Candacia. The few individuals shown on the Atlantic lines were those near the edge of the main concentration which was invariably nearer the coast. For example, in 1949, although Candacia rarely appeared outside the 200 fathom contour, it was present and often in comparatively high numbers from March to December in the coastal water sampled by "W" and "X". Again in 1950, it was taken in the coastal water from June until the end of the year. So, in these histograms, the appearance of Candacia on "W" and "X" should be taken rather as an indication of the extent of the seaward spread of the coastal plankton. Nevertheless, in 1950, as in every other year for which information is available, Candacia appeared to spread in the North Sea as the autumn progressed; a comparison of the histograms for "A" and "K" indicates this (Fig. 8). Metridia is commonly found at 10 metres over the deeper Atlantic water on those parts of the records taken at night but it rarely extends to the shore side of the 200 fathom contour. The striking feature of 1950 (Fig. 9) was the successful population found on "W" and "X" in the spring, which was far richer than anything previously found in the survey. Interpreting the distribution of Metridia on the basis of water movement, or drift from the Atlantic into the North Sea, it is tempting to associate this dense spring population in the Atlantic with the slight increases in numbers on "A" and "K" in May and later the June and August peaks on "W" and "X" with the September and October peaks on "A" and "K". However, there is some evidence on each of these four lines of at least three distinct generations and, inevitably, it is difficult to distinguish between true movement and a succession of local breeding.

The results for the pteropods (Figs. 10 and 11) add little to the information obtained in 1948 and 1949. They appeared to be less common than usual and no clear trend is detectable from the histograms. The distributions of Tomopteris and the Thaliacea, on the other hand, showed a well marked succession from the Atlantic into the North Sea and north eastwards to the "T" route. In Figs. 12 and 13 the few months for which records were

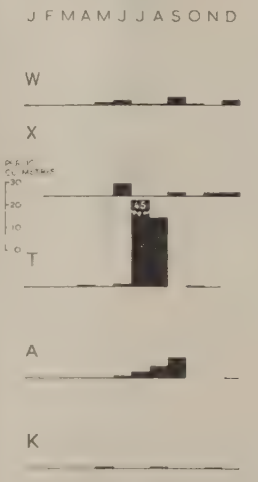


Figure 10.

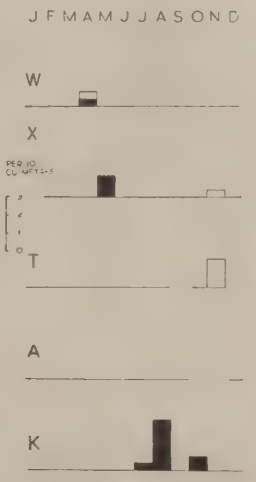


Figure 11.

Fig. 10. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder routes, W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T.

Fig. 11. Histograms representing the relative numbers of *Clione limacina* (solid) and *Clio clione* (open line) taken month by month on the Recorder routes, W, X, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes W, X, and T.

available on the "J" and "V" routes are added (see Fig. 1) and in both cases it is possible to trace the apparent movement. As in the previous years, May and June were the most successful months for Tomopteris on the Atlantic lines and there was a progressive shift of its period of occurrence until it reached the "K" route in September. A similar succession is apparent for the Thaliacea for which 1950 was undoubtedly a good year in comparison with those immediately preceding. In 1948 and 1949 a few isolated doliolids were taken on the Atlantic routes in June and July and in 1946, before these two routes were available, an average of about 6 per cu. metre were recorded on "V" in July. The doliolids and salps are not differentiated in Figure 13 but it can be said that, although both were present, the doliolids were far more common than the salps and preceded them in time: in the main the salps had a more northerly distribution. The warm water copepod, *Rhincalanus nasutus*, which was found in reasonable numbers in the Atlantic in 1949 after two lean years, was particularly successful in 1950 and it may be significant that in the last year when it was common, 1946, doliolids were also taken in mid-summer on the "V" route.

In many respects the plankton on the "T" route, included here for the first time, seems to have more in common with that of the North Sea than that on the Atlantic routes. This may be an important generalisation from the point of view of the Recorder Survey because there has been the possibility that the apparent differences between the North Sea and the open Atlantic water resulted from all the samples being taken at 10 metres, regardless of the overall depth; the behaviour of the plankton in the shallower or coastal Atlantic water was very similar to that in the North Sea. In 1950, in each point in which the deeper parts of "W" and "X" differed from "A" and "K", the plankton over the deep part of "T" was more like the latter than the former. For example, there was a rich population of Calanus in the spring and the total copepods flourished in the spring as well as in the late summer; the indicator forms, Tomopteris and Thaliacea, were not found on "T" until the latter part of the year when they had also reached the North Sea, while there was no indication on "T" of the May-July concentrations taken on "W" and "X"; *Metridia lucens* did not appear on "T" until late autumn, if one considers those caught in January, February and March as belonging to the previous winter population.

K. M. Rae.

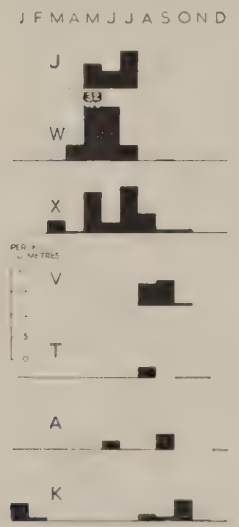


Figure 12.

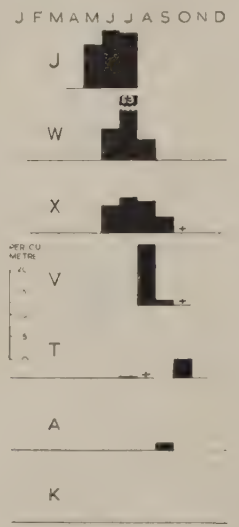


Figure 13.

Fig. 12. Histograms representing the relative numbers of *Tomopteris* taken month by month on Recorder routes, J, W, X, V, A, and K; only that part of the tow taken outside the 200-fathom contour is included on the routes J, W, X, V, and T.

Fig. 13. Histograms representing the relative numbers of *Thaliacea* taken month by month on Recorder routes, J, W, X, V, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on the routes J, W, X, V, and T.

Plankton Investigations from Scottish Research Vessels.

Phytoplankton patches were noted in inshore waters in very early spring (January/February in the Firth of Forth area, and off Malin Head (North Ireland) in March) when the species found were chiefly Asterionella, Thalassiosira, Coscinodiscus and Lauderia, but the general spring increase in the North Sea did not occur until April/May when *Thalassiothrix nitzschioides*, *Chaetoceros debilis*, Thalassiosira, Lauderia, Skeletonema and *Nitzschia seriata* were all abundant. In fact, 1950 was a year in which in the area investigated no single phytoplankton species dominated to the relative exclusion of others. Halosphaera was also abundant in the north-western North Sea from Shetland to Aberdeen in May and June, but in the north-

eastern North Sea dinoflagellates were more abundant. Phytoplankton continued to be abundant throughout the summer in areas were oceanic and coastal waters mixed.

A patch of 'white water' in the Fladen area in July/August was found to be associated with the presence of motile colourless bacteria (Pseudomonas?). Counts in the laboratory a few days after sampling gave figures in the region of 10,000 cells per mm.^{3}).

The autumn inflow into the northern-western North Sea in 1949 brought with it species such as *Sagitta serratodentata* and Rhincalanus which survived the winter there, but were not found on the north-eastern side. *S. elegans* was found in all coastal waters in the area. *Calanus finmarchicus* became abundant in waters north and west of Scotland in March, but was not generally abundant in the northern North Sea until May when the Calanus population came into the area (mostly as stage V) with *Eukrohnia hamata* from northern waters.

A rich oceanic plankton community first sampled off the west Scottish coast (west of Barra Head) in March was found to be entering the southern end of the Faroe Channel in May and continued to do so at least until September, but was not so evident on the line of stations between Faroe and Shetland. This community included Rhincalanus, Eucalanus, Clio, salps and doliolids, Hippopodius, Vogtia, *Sagitta maxima* and *S. serratodentata* and many bathypelagic or rare exotic species. Some of the more tolerant of these exotic species were found in the North Sea and Moray Firth areas in June, July and August, and are believed to have entered via the Orkney passages. These species were not found on the Faroe-Shetland line nor entering the North Sea north and east of Shetland until November.

During the summer dense congregations of *Hybocodon prolifer* were found on the Fladen, east of Shetland and Fair Isle—i.e. to the north and east of the oceanic species—and in such large numbers that they made herring nets difficult to handle and may well have had an effect on the horizontal or vertical movements of the herring shoals. Calanus persisted longer near Shetland than elsewhere in the North Sea. Calanus and Euchaeta had by this time become abundant in the upper 100 mm. over the Norwegian Deep where also a population of Agalmopsis occurred.

Salpa fusiformis, one of the oceanic species that entered the North Sea via the Orkney passage in June, was found on the Peterhead herring grounds in July/August, but showed little evidence of further distribution in the North Sea, although *Dolioletta gegenbauri* had extended its distribution southwards at least to 55°30′N. and eastwards to 1°E. by October. Both salps and doliolids were absent in the collections taken north and east of Shetland at that time, but were present there in November.

The presence of *Sagitta setosa* north of the Irish Sea suggests an outflow of Irish Sea water into the inshore waters off the south west of Scotland.

The list of rare exotic species which has been included in the past four issues of *Annales Biologiques* has been omitted this year, but it is proposed to include a critical review of the occurrence of the more unusual exotics every few years.

J. H. Fraser.

THE FISH

Haddock.

Scottish Investigations.

The haddock shoals of the Northern North Sea and off North West and West Scotland have been sampled during 1950, as in previous years (Parrish 1949 and 1950), by the F. R. S. "Explorer". Hauls of one-hour's duration were carried out using an otter trawl with a small mesh cover, and the haddock caught were measured and sexed and scales were taken for subsequent age analysis.

Age Composition of the Stock.

The age composition of haddock caught by "Explorer" during 1950 is presented (Table 1) for the periods February to March, April to June, July to September and October to November, in each of the six areas sampled. The limits of these, the Northern, North Central, Central, Moray Firth and Orkney, Firth of Forth and Western areas are described by Parrish (1949).

It is clear from this table that during 1950 the commercial fishery was principally sup-

Table 1. Age Composition of Haddock caught by F. R. S. "Explorer" in 1950.

Per 10 Hours Trawling.

Month.	Northern Area Feb./Mar.	Apr./June	July/Sept.	Oct./Nov.	All months	North Central Area Feb./Mar.	Apr./June	July/Sept.	Oct./Nov.	All months	Central Area Feb./Mar.	Apr./June	July/Sept.	Oct./Nov.	All months
Hours trawling	11	19	2[1]	7[1]	39	7[1]	20	9	7[1]	43	7[1]	7[1]	10	13	37
Year-Class					Weighted Means					Weighted Means					Weighted Means
1949	111	228	45	207	182	954	403	507	826	583	704	483	1376	765	865
1948	396	457	175	256	389	781	493	189	507	477	409	564	433	168	360
1947	174	91	30	111	115	29	24	1	33	21	33	23	—	3	12
1946	7	11	—	7	9	—	4	5	4	4	—	2	—	2	1
1945	219	139	90	156	162	84	52	2	36	44	39	19	—	8	14
1944 to 1940	18	7	15	19	13	6	3	1	—	3	11	3	—	—	3
All ages	925	933	355	756	869	1854	979	696	1406	1132	1196	1094	1809	946	1255

	Moray Firth and Orkney					Firth of Forth					Western Area				
Hours trawling	3[1]	8[1]	3[1]	3[1]	17	—	—	—	10	10	16	10	31	4[1]	61
Year-Class					Weighted Means					Weighted Means					Weighted Means
1949	—	40	663	13	138	—	—	—	23	23	—	56	1	5	10
1948	433	901	913	667	779	—	—	—	65	65	11	204	22	48	51
1947	10	15	10	13	13	—	—	—	12	12	—	33	15	60	17
1946	—	—	—	—	—	—	—	—	—	—	—	2	—	5	1
1945	7	21	—	27	16	—	—	—	—	—	9	79	72	95	58
1944 to 1940	—	2	—	3	1	—	—	—	—	—	—	9	—	10	2
All ages	450	979	1586	723	947	—	—	—	100	100	21	383	110	223	139

[1] Based on a small number of hours fishing, and hence less representative than other figures.

ported by the 1945 and 1947 broods and by the larger members of the 1948 brood.

The 1949 brood was predominantly scattered in the Central area, as was the 1948 brood during the previous year (1949). This latter during 1950 had spread fairly evenly over the Northern, North Central and Central areas, and high concentrations were taken in the Moray Firth and Orkney region.

The 1946 brood was practically extinct by 1950, but the 1945 and 1947 broods were still represented in all areas (excluding the Firth of Forth) so as to play an important part in the commercial fishery.

Representatives of the oncoming 1950 brood were first taken in "Explorer's" trawl during July and were sampled from then to November (Table 2). This brood was chiefly located in the Northern and North Central areas and proved to be about half as numerous as the 1949 brood, and less than half as numerous as the 1948 brood. The 1950 brood was, however, better than either of the 1946 or 1947 broods had been and may be classed as of "poor to average" strength.

Size Composition.

As in previous years, the mean lengths of the younger broods were consistently greater throughout the year in those from the Central area than in those from other areas (Table 3), this distinction being evident even in fish of five years of age. The smallest fish were taken in the deep waters of the Northern area.

The Commercial Fishery.

During 1950, there was a rise in the total haddock landings from the whole of the North

Table 2. Distribution and Density of the 1950 Brood in "Explorer" Catches.

July to November 1950.

Area	No. of fish	No. of hours	Per 10 hours
Northern	159	9	219
North Central	472	16	295
Central	202	23	98
Moray Firth	48	6[1]	80
Firth of Forth	13	10	13
West	98	35	28
Total for All Areas	992	99	100

[1] Based on a small number of hours fishing and hence less representative than other figures.

Table 3. Mean Lengths (cm.) and Standard Errors of Haddock of each Age-Group from the North Sea and Western Grounds—1950.

Year-Class	Age	Month	Northern			North Central			Central			Moray Firth and Orkney			Firth of Forth			West		
			Mean	S. E.	No. fish	Mean	S. E.	No. fish	Mean	S. E.	No. fish	Mean	S. E.	No. fish	Mean	S. E.	No. fish	Mean	S. E.	No. fish
1950	0+	July-Sept.	8.1	0.263	7	12.5	0.125	250	8.9	0.072	120	12.4	0.362	21	—	—	—	11.8	0.205	60
		Oct.-Nov.	17.0	0.102	152	15.6	0.103	222	15.8	0.181	82	15.0	0.253	27	14.6	0.368	13	17.1	0.192	38
1949	1+	Feb.-March	14.9	0.093	123	15.8	0.015	668	17.2	0.018	493	—	—	—	—	—	—	—	—	—
		Apr.-June	16.9	0.073	433	17.5	0.022	613	18.7	0.031	338	19.3	0.312	32	—	—	—	18.2	0.259	56
		July-Sept.	21.1	0.455	9	20.1	0.011	4563	23.3	0.015	1376	23.7	0.030	199	—	—	—	28.0	1.526	3
		Oct.-Nov.	24.2	0.123	145	25.2	0.025	578	29.4	0.059	994	27.0	0.408	4	29.6	0.299	23	29.0	2.000	2
1948	2+	Feb.-March	24.5	0.198	436	25.6	0.106	547	28.8	0.147	286	25.4	0.188	130	—	—	—	26.5	0.455	17
		Apr.-June	25.1	0.070	868	25.8	0.078	946	29.5	0.169	395	26.8	0.098	721	—	—	—	26.5	0.175	164
		July-Sept.	30.2	0.315	20	29.3	0.090	983	31.4	0.132	433	31.6	0.186	274	—	—	—	34.2	0.313	69
		Oct. Nov.	30.9	0.187	179	32.2	0.167	355	36.1	0.212	218	32.3	0.155	200	36.5	0.311	65	32.9	0.364	19
1947	3+	Feb.-March	31.2	0.198	192	34.1	0.649	20	37.8	0.655	23	37.7	4.978	3	—	—	—	—	—	—
		Apr.-June	30.3	0.166	173	32.3	0.530	49	38.0	0.736	16	35.5	0.848	12	—	—	—	31.2	0.328	33
		July-Sept.	36.8	2.135	6	—	—	—	—	—	—	37.0	0.577	3	—	—	—	39.5	0.488	45
		Oct. Nov.	34.6	0.349	78	34.2	0.566	16	42.00	2.000	2	39.5	2.179	4	43.9	0.722	12	39.7	0.696	24
1946	4+	Feb.-March	32.5	1.049	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Apr.-June	32.0	0.790	21	36.5	1.523	8	—	—	—	—	—	—	—	—	—	38.0	1.000	2
		July-Sept.	—	—	—	40.8	1.158	5	—	—	—	—	—	—	—	—	—	—	—	—
		Oct. Nov.	32.4	1.330	5	41.0	0.577	3	41.0	0.577	3	—	—	—	—	—	—	47.0	5.000	2
1945	5+	Feb.-March	35.6	0.290	241	34.7	0.455	59	45.0	0.765	27	41.5	0.500	2	—	—	—	40.9	0.917	14
		Apr.-June	33.4	0.184	265	36.1	0.520	103	44.3	1.856	13	42.5	1.106	17	—	—	—	—	—	—
		July-Sept.	38.5	0.864	18	49.0	4.000	2	—	—	—	—	—	—	—	—	—	43.9	0.270	223
		Oct.-Nov.	37.5	0.355	109	40.2	0.906	25	51.7	1.693	10	42.5	2.802	8	—	—	—	43.2	0.759	38

Table 4. Landings of Haddock by British Trawlers from North Sea Regions in 1950.

	N. of Lat. 57°30′N.			Lat. 55°N. to 57°30′N.			South of Lat. 55°00′N.			All Areas[1]		
	Weight landed (cwts.)	100 Hrs. fishing	Weight landed/ 100 hrs.	Weight landed (cwts.)	100 Hrs. fishing	Weight landed/ 100 hrs.	Weight landed (cwts.)	100 Hrs. fishing	Weight landed/ 100 hrs.	Weight landed (cwts.)	100 Hrs. fishing	Weight landed/ 100 hrs.
Jan.-March	57,070	462	123.4	11,497	204	56.4	1,318	1,758	0.7	81,035	2,582	31.4
April-June	44,515	584	76.2	30,085	564	53.4	3,498	900	3.9	89,507	2,210	40.5
July-Sept.	36,655	375	97.7	91,053	1,130	80.6	14,247	1,044	13.6	158,661	2.731	58.1
October	18,794	170	110.6	37,756	398	94.9	4,643	470	9.9	71,629	1,110	64.5

[1] Includes landings from unknown rectangles.

Sea to a level between those obtained in 1948 and 1949. There was, however, very little change in the landings per 100 hours fishing (Table 4).

South of latitude 55°N. there was a rise in both total landings and landings per 100 hours during all periods of the year, whereas north of this region there was a rise during January to March but a decrease later for certain seasons of the year.

R. Jones. W. Main.

Table 5. Landings of Whiting by British Steam Trawlers from North Sea. 1947—50.

Quarterly Period	Year	North of Latitude 57°30′N. Wt. landed in 100 cwts.	100 Hours fishing	Wt. landed per 100 hrs.	Latitude 55°N. to 57°30′N. Wt. landed in 100 cwts.	100 hours fishing	Wt. landed per 100 hrs.
January	1947	477	424	113	73	211	35
to	1948	810	610	133	43	211	20
March	1949	283	446	63	61	254	24
	1950	286	462	62	28	174	16
April	1947	773	445	174	109	522	21
to	1948	769	708	109	59	438	13
June	1949	291	480	61	35	575	6
	1950	274	584	47	66	564	12
July	1947	84	226	37	153	818	19
to	1948	125	336	37	243	927	26
September	1949	113	420	27	179	995	18
	1950	219	375	58	185	1130	16
October	1947	190	418	45	334	944	35
to	1948	536	752	71	198	599	33
December	1949	288	541	53	207	835	25
	1950	473	617	77	181	846	21
Year	1947	1524	1513	101	669	2495	27
	1948	2240	2406	93	543	2175	25
	1949	975	1887	52	482	2659	18
	1950	1251	2039	61	461	2744	17

Quarterly Period	Year	South of Latitude 55°N. Wt. landed in 100 cwts.	100 hours fishing	Wt. landed per 100 hrs.	All Areas [1] Wt. landed in 100 cwts.	100 hours fishing	Wt. landed per 100 hrs.
January	1947	214	1312	16	864	2071	42
to	1948	148	1830	8	1133	2819	40
March	1949	70	1707	4	487	2544	19
	1950	100	1758	6	469	2582	18
April	1947	91	1463	6	1091	2582	42
to	1948	63	1307	5	1049	2684	39
June	1949	20	1027	2	376	2411	16
	1950	50	900	6	426	2210	19
July	1947	107	1568	7	401	2832	14
to	1948	91	1314	7	537	2819	19
September	1949	95	1391	7	447	3085	14
	1950	114	1044	11	574	2731	21
October	1947	115	1606	7	735	3221	23
to	1948	99	1564	6	1052	3288	32
December	1949	76	1577	5	647	3269	20
	1950	129	1454	9	842	3173	26
Year	1947	527	5949	9	3091	10706	29
	1948	401	6015	7	3771	11610	32
	1949	261	5702	5	1957	11309	17
	1950	394	5156	8	2311	10695	22

[1]) Includes landings from unknown areas.

Whiting.

British Statistics.

Following the preliminary survey of whiting landings by British vessels before and during the war (Volume VI), the above figures (Table 5) are presented as a summary of the landings by British vessels for the post-war years 1947—1950. They are set out in the form adopted for haddock in Volume VI (and continued for 1950 in this number) and will be reviewed from time to time.

R. W. Ellis.

Plaice.

Scottish East Coast.

After a preliminary statement in Volume VI of *Annales Biologiques* the following report represents the first account of the immature plaice of the Scottish east coast bays since that contained in the 57th Annual Report of the Fishery Board for Scotland (1938).

Surveys by F. R. S. "Kathleen", using a 28 ft. otter trawl with small mesh over the cod-end, were carried out throughout the year and covered Moray Firth localities such as the Dornoch Firth, Nairn, Burghead, Spey and Aberdour Bays in April-May and in October-November, Aberdeen Bay in February-March, May and November and (further south) Lunan, Carnoustie, St. Andrews Bays, and the Firth of Forth in March and May.

The tables below are for the comparable period April-May and give:

(I) the size distribution by 5 cm. groupings,
(II) the numbers and age composition of the catch per four hours fishing (one hour in each of four depth zones from 4 to 37 metres);
(III) the same expressed as percentages, and
(IV) the mean sizes.

The tables show that the various populations have certain features in common—an approximately similar size-range with a preponderance of fish under 26 cm. and an age structure largely comprised of groups I—IV. Local variations, however, have been observed and have been attributed to differences in the brood strengths and growth rate as well as to the variability of fishing intensity in those territorial waters where seine-net fishing by small vessels is permitted and on other inshore grounds adjacent to areas which may be closed or open to fishing.

Table 6. Scottish East Coast April-May 1950.

	Size Composition (by 5 cm. groups) %.								Age Composition. Nos. per 4 hours fishing 4–37 metres.							
	10 cm. and under	11—15	16—20	21—25	26—30	31—35	36—40	41+	I 1949	II 1948	III 1947	IV 1946	V 1945	VI 1944	VII 1943	
Moray Firth																
Dornoch Firth	13.9	40.5	33.3	10.6	1.5	0.1	—	—	272	526	735	256	27	9	1	= 1826
Nairn Bay	4.1	56.0	29.6	7.5	2.6	0.1	0.1	—	188	289	306	53	30	13	–	= 879
Burghead Bay	4.0	44.1	37.9	10.9	3.0	0.2	—	—	61	399	442	85	11	2	1	= 1001
Spey Bay	20.0	31.4	27.6	10.3	9.2	1.1	0.5	—	89	131	177	39	5	5	–	= 446
Aberdour Bay	5.5	7.1	26.3	37.5	17.3	5.1	1.0	0.3	17	160	78	50	6	1	–	= 312
Aberdeen Bay	2.1	38.5	45.3	8.2	3.9	1.6	0.4	—	15	579	68	12	2	–	–	= 676
St. Andrews Bay	14.3	42.6	18.2	20.7	1.2	—	—	—	475	118	58	207	7	–	–	= 865
Firth of Forth																
Largo Bay	6.4	35.3	26.5	20.5	6.9	3.9	0.3	0.2	270	224	81	80	12	1	–	= 668
Aberlady Bay	—	4.0	18.0	24.0	42.0	6.0	2.0	—	2	8	11	25	4	–	–	= 50

	Age Composition (%).							Mean Sizes (cm.).						
	I	II	III	IV	V	VI	VII	I	II	III	IV	V	VI	VII
Moray Firth														
Dornoch Firth	14.9	28.9	40.3	14.4	1.5	0.5	+	9.2	12.8	16.7	21.2	24.0	26.5	27.0
Nairn Bay	21.4	32.9	34.8	6.0	3.4	1.5	—	11.5	13.6	17.0	21.6	24.3	28.3	—
Burghead Bay	6.1	39.9	44.2	8.5	1.1	0.2	0.1	10.1	13.6	17.9	24.0	25.5	22.0	33.0
Spey Bay	20.0	29.4	39.7	8.8	1.1	1.1	—	8.6	13.9	19.4	25.8	27.2	30.4	—
Aberdour Bay	5.5	51.3	25.0	16.0	1.9	0.3	—	8.2	21.7	20.7	26.0	31.5	49.0	—
Aberdeen Bay	2.2	85.4	10.1	1.7	0.2	—	—	8.7	16.0	24.4	27.7	35.7	—	—
St. Andrews Bay	54.4	13.5	6.6	23.7	0.8	—	—	11.0	16.2	18.7	21.4	24.6	—	—
Fifth of Forth														
Largo Bay	40.4	33.5	12.0	12.0	1.8	0.2	—	11.7	20.5	19.6	27.1	30.7	43.0	—
Aberlady Bay	4.0	16.0	22.0	50.0	8.0	—	—	14.0	22.1	23.2	26.5	31.5	—	—

In the Moray Firth, where commercial fishing within territorial limits is prohibited, the westerly localities Dornoch Firth, Nairn Bay and Burghead Bay were characterised by fairly high density of slow-growing plaice, the narrow size-range 11—20 cm. and age-groups II and III in approximately equal strength dominating the populations. In Aberdour Bay on the east section of the Moray-Firth coast smaller numbers and faster growth raised the proportion of larger fish in the stock which was also largely composed of the same two age-groups, the younger II-group predominating. Spey Bay, lying between the east and west grounds, closely resembled the latter in size and age composition, but was more comparable with Aberdour in numbers and growth rate.

In contrast, the stocks in the permissible areas from Aberdeen Bay to the Firth of Forth were more varied in character—the main features being:

(1) the high predominance of group II and weak representation of other age-groups in the quick-growing locality of Aberdeen Bay;
(2) in St. Andrews Bay the prolonged survival of the slow-growing 4-year-old 1946 brood, the weak representation but higher-than-average growth of groups II and III and the good recruitment of the oncoming group I (1949 brood);
(3) in the Firth of Forth, the contrasting values in abundance, size and age composition of two bays in that area both of which support fast growth: Largo Bay comparatively well stocked with young fish of sizes favourably comparable with all other localities and Aberlady Bay poorly stocked with relatively larger and older fish.

B. B. Rae. J. M. Lamont.

Lemon Sole.

In 1950 the Scottish research vessels "Explorer" and "Scotia" caught 1750 lemon soles in 394 hours fishing in the North Sea and off the north and west coasts of Scotland. This represents more extensive sampling than that dealt with in the *Annales Biologiques* for 1948, the last year in which a report was submitted on this species.

The size of these fish is shown by the following figures representing the numbers in each 5 cm. group per thousand fish:

< 21 cm.	21–25	26–30	31–35	36–40	41–45	46–50
128	228	302	233	91	17	1

The 26—30 cm. group contains the largest number but it will be observed that considerable numbers of fish below the marketable size are retained in the cod-end in which the mesh dimension most frequently in use was 80 mm. These totals include 64 small lemon soles, all less than 23 cm., retained by the small mesh covering on the cod-end, but even if these are excluded it is clear that large numbers of immature and undersized fish are being killed by the trawl.

The age composition of the research records per thousand fish is as follows:

Brood	1949	1948	1947	1946	1945	1944	1943
No. of fish	2	21	139	234	345	97	75
Brood	**1942**	**1941**	**1940**	**1939**	**1938**	**1937**	**1936**
No. of fish	17	23	13	19	8	5	2

Fourteen broods from 1^+ to 14^+ years of age are represented in the year's total, of which all but the youngest two contribute to the stock of marketable-sized fish. Two broods provided nearly 60% of the numbers caught by the two research vessels—the 1945 brood alone yielding almost 35% and indicating good recruitment to the lemon sole population in that year. The numbers of the 1946 brood also suggest good to medium recruitment. Fish of six years of age and over formed 26% of the total; although none of the older age-groups was remarkably strong their cumulative effect by weight on the commercial catches was of the utmost value in maintaining a good supply of medium to large fish. The advent of the successful younger broods was reflected in the Aberdeen market by the larger numbers of small lemon soles landed throughout the year than at any time since the war. Samples of small lemon soles from Aberdeen market were examined during the summer and confirm this conclusion. In one sample of 217 fish, for example, as much as 51% belonged to the 1945 brood and 28% to the 1946 brood.

Operating mainly in territorial waters and in the Moray Firth the motor vessel "Kathleen" caught 570 lemon soles. Most of these fish were taken about the three mile limit. These fish were generally smaller and younger than those

caught by the bigger vessels, their age composition being as follows (again per thousand fish):

Brood	1949	1948	1947	1946	1945	1944	1943
No. of fish	—	44	316	303	230	39	28

Brood	1942	1941	1940	1939	1938	1937	1936
No. of fish	2	12	3	16	3	2	2

The outstanding broods in this case are those of 1947 and 1946, which together provided over 60% of the total and of 1945 (23%). The younger age composition of the catch compared with the bigger vessels is attributed to:

(a) the "Kathleen's" operations being in an area close to the nursery grounds for lemon soles, and

(b) the heavy intensity of fishing by commercial vessels, chiefly seiners, on grounds adjoining territorial waters with the consequent reduction in the numbers of the larger and older lemon soles.

Fish of six years of age and over formed less than 11% of the "Kathleen's" total as compared with 26% of the bigger vessels' catch. In the course of one cruise the "Kathleen" surveyed grounds in the Moray Firth which are fished by local seine net fleets. On this occasion the lemon sole population was found to be intermediate in age composition between the inshore stock, normally sampled by "Kathleen", and that of the typical trawling grounds further offshore.

B. B. Rae.

Rare Fishes.

The outstanding feature of the Scottish rare fish records for 1949 was the invasion of local waters by Ray's bream (*Brama raii*) in the last four months of the year. Beginning early in September, north-west of the Butt of Lewis, records were obtained of 37 fish over an area of home waters which increased progressively up to the end of the year. The extent of this invasion is indicated by the spread of the records as far apart as Flugga in the Shetlands, the Firth of Forth and 180 miles N.E.$\frac{1}{4}$E. from Buchanness. A reference in the "Fishing News" of 10th December 1949 to a stranding at Whitby on the north-east English coast shows that the penetration of the North Sea went even further than the waters normally fished by Scottish vessels. Three stragglers were later obtained between 1st January and 1st March 1950—all from strandings in the Moray Firth.

In contrast to the 40 fish resulting from the 1949—1950 season only five specimens of this species were obtained during the corresponding 1950—1951 season. Four of these were taken by one long liner near St. Kilda in August and the remaining specimen by trawl south-east of Aberdeen on 30th September. None has been reported up to March 1951.

Other rare or interesting fish records from the catches of Scottish fishing vessels during 1950 include the following:

Acipenser sturio (sturgeon), 4 (3 North Sea, I, II, VII and 1 West Coast, V).

Aphanopus carbo (black scabbard fish), 3 (2 George Bligh Bank, VI and 1 Rockall, VII).

Mola mola (sunfish), 4 (1 Rockall, VIII, 1 St. Kilda, VIII and 2 Moray Firth, IX).

Raniceps raninus (lesser fork-beard), 2 (North Sea, VII, IX).

Belone belone (garfish), 2 boxes by drifter 198′ E. x N. from Aberdeen and 30 specimens by another vessel from same area, IV.

Scomberesox saurus (saury pike), 2 (Outer Moray Firth, VIII).

Trachypterus arcticus (deal fish), 1 (Rockall Bank, VII).

Torpedo nobiliana (electric ray), 1 (West Coast, VI).

Myliobatis aquila (eagle ray), 1 (North Sea, off St. Abb's Head, X).

B. B. Rae. E. Wilson.

Southern North Sea.

INTRODUCTION

Contributions have been received from Mr. HELGE THOMSEN, Mr. SMED, Mr. BOEREMA, Dr. TÅNING, Dr. JENSEN, Mr. RICHARDSON and Mr. WIMPENNY. Although fewer reports are to hand than last year, the reduction is probably more apparent than real as there is now a tendency towards more long-term projects not susceptible to annual reporting.

Environment.

Hydrography. Mr. SMED's salinity anomalies for an area in the southern North Sea indicate a preponderance of negative values in the post-war years in contrast with the pre-war period 1933—1939 when the salinities were mainly above normal. For the Vyl Lightvessel Mr. THOMSEN shows that both surface and bottom temperatures and salinities were above normal in 1950.

Fish Species.

The Demersal Catch. Leaving on one side the fact that the fishing capacity of trawlers has increased, Mr. BOEREMA shows that the figures for the Dutch catch when similar ships are compared indicate that the decline in the densities of the fish stocks which occurred between 1945 and 1949, ceased in 1949 and 1950.

Cod and Haddock. The Dutch work suggests that there has been little change in the stock of these species. In the case of haddock there was an increase in the density of the small individuals.

Plaice. Investigations into the density of 0-group in Danish North Sea waters show that 1950 was a predominant year-class of the same order as 1937, 1939 and 1946. Both Dutch and Danish fisheries indicated that there was, on the whole, an increase in the density of this species compared with 1949, the Dutch observations suggesting that this was due to the good survival of some recent brood-years. Dr. JENSEN's note shows that on the Horn's Reef ground in June the population was about 25% more numerous than the pre-war average and that it was mainly composed of younger fish of which the III-group (1947 year-class) was dominant. The IV-group (1946 year-class) dominated the Danish commercial fishery. A short account of the variation of sex-ratios in the English steam-trawler catch of plaice between 1920 to 1949 and of the inshore catch at Rye Bay from 1941—1950 suggests a relative decrease of males with fishing in offshore waters and of females inshore.

Dab. Danish quantitative investigations in the Horn's Reef area showed a density similar to that of pre-war years.

Sole. Catches of the smaller Dutch vessels indicated an increased density of soles due to the survival of recent brood years, in particular that of 1947.

Sprat. English echo-search surveys dealt with by Mr. RICHARDSON revealed that the pattern of shoal distribution in the sprat season 1950—51 was similar to the one found the previous year, and was again linked to a poor fishery off the SE. coast of England.

R. S. WIMPENNY.

ENVIRONMENT

Hydrography.

Table 1. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies from these Means.

(From the Danish Meteorological Institute, Nautical Dept.).

Month:	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity								**Surface**								
Mean.....	32.4	32.4	32.9		32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6	32.4	32.4	32.9
1949.....	0.7	1.8	1.2	1950	1.0	1.4	2.1	0.8	1.3	0.8	0.5	1.0	1.0	1.4	1.4	1.0
								Bottom								
Mean.....	32.6	32.7	33.0		33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.7	32.8	32.6	32.7	33.0
1949.....	0.8	1.9	1.4	1950	1.2	1.6	2.0	1.4	1.6	0.6	0.7	1.2	1.1	1.6	1.3	1.4
Temperature								**Surface**								
Mean.....12.2		8.5	5.4		3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0	12.2	8.5	5.4
1949.....	2.7	2.4	2.2	1950	1.5	1.5	1.7	1.4	0.4	0.4	0.6	1.4	1.1	0.3	0.0	0.2
								Bottom								
Mean.....	12.7	9.0	6.2		3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.2	12.7	9.0	6.2
1949.....	2.6	2.7	1.7	1950	1.6	1.5	1.6	1.3	0.7	1.1	1.0	1.1	1.2	0.4	0.0	0.3

HELGE THOMSEN.

Monthly Anomalies of the Surface Salinity in an Area of the Southern North Sea during the Years 1902—39 and 1946—50.

For the southern North Sea a fairly considerable number of surface salinity observations, covering the years from 1902 onwards, is recorded in the hydrographical card-index of the International Council. These data may, when worked up, supply information of some value to marine biology. Below are given monthly means of the anomaly of the surface salinity year by year up to 1950 for the area G: $53^1/_2°$—54° N., 1°—4° E.; 54°—56° N., 1°—5° E. (see Fig. 1), calculated on the basis of the card-index material.

As the salinity varies locally, and as the distribution of the observations over the area ordinarily is not the same from one year to another, monthly salinity means for the area cannot be expected to give comparable values. Therefore the following method was used: The area in question was divided into squares of $1° \times 1°$ or $^1/_2° \times ^1/_2°$. The grand monthly means for their corners for the period 1902—28 are to be found in "Atlas de Température et Salinité de l'Eau de Surface de la Mer du Nord et de la Manche" (published by Service Hydrographique in 1933). From these values the grand monthly means of the squares have been obtained by calculating means for each month and each square from the 4 means applying to the corners of a square. For each of the squares and for each month of the years

Figure 1. Area G.

1902—39 and 1946—50 (for the war years no observations are available) the anomaly of the salinity was then computed, and these anomalies were averaged over the area in question.

Table 2. Monthly Anomalies ($\triangle$ ‰) and Numbers (n) of Observations of the Surface Salinity in the Area G (see Fig. 1) during the Years 1902–39 and 1946–50.

	January		February		March		April		May		June		July		August		September		October		November		December	
	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n	△	n
1902	—	—	—	—	—	—	—	—	—	—	—	—	—	—										
1903	—	—	0.15	5	—	—	0.13	1	0.17	4	—	—	—	—	0.30	1	—	—	—	—	0.18	5	—	—
1904	0.02	1	—0.20	4	—	—	—0.17	1	—0.06	4	—	—	—	—	0.12	4	—	—	—	—	—0.18	5	—	—
1905	—	—	—0.08	4	—	—	—	—	—0.09	5	—	—	—0.20	1	—0.13	5	—	—	—	—	—0.20	4	—	—
1906	0.05	8	− 0.03	18	− 0.07	12	0.11	21	0.13	30	0.09	27	0.09	3	0.00	23	0.11	4	—	—	0.05	21	0.12	5
1907	− 0.04	24	0.09	25	0.11	37	0.19	33	0.29	43	0.28	23	− 0.04	22	0.14	47	0.08	69	0.10	60	0.04	59	− 0.02	47
1908	0.07	41	0.12	17	− 0.09	21	0.05	20	0.04	28	0.05	17	0.22	55	0.18	52	0.12	55	0.16	71	0.19	42	0.23	30
1909	0.05	4	− 0.07	34	0.01	56	−0.12	45	−0.65	5	0.05	13	0.11	69	0.10	41	0.12	85	0.06	76	0.08	2	—	—
1910	—	—	—0.07	5	—	—	—	—	0.05	11	—	—	0.06	26	0.04	11	—0.04	24	—0.07	25	—0.19	5	—	—
1911	—	—	—0.15	7	—0.03	49	—	—	—0.05	13	—1.05	30	0.05	3	—0.01	55	0.04	29	0.05	71	0.08	2	—	—
1912	—	—	0.01	1	—	—	—	—	—0.06	4	—0.05	15	—	—	0.01	9	0.11	7	0.03	15	—	—	—	—
1913	—0.04	2	—0.08	6	—	—	—0.02	2	—0.30	15	—0.07	1	—0.16	7	—	—	—0.20	8	0.04	5	—0.09	20	—	—
1914	—	—	—	—	—0.26	4	—0.20	12	—0.18	6	—0.24	9	0.18	1	—0.14	13	—	—	—0.24	10	—	—	—	—
1915	—	—	—	—	− 0.30	1	0.23	1	0.28	1	0.33	3	—0.43	3	—0.15	17	—	—	—	—	—	—	—	—
1916	0.09	3	− 0.44	1	—	—	—	—	—	—	—	—	0.24	4	0.21	3	0.31	3	0.37	1	—1.43	1	—	—
1917	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—0.15	2	−0.31	4	—0.98	1	—	—
1918	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1919	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1920	—	—	0.11	1	—	—	0.07	3	0.08	3	0.25	5	0.22	5	—	—	0.28	2	0.27	1	0.27	1	—	—
1921	0.12	5	—0.01	21	—0.09	17	—0.11	3	0.09	14	0.15	13	0.19	17	0.20	21	0.00	29	0.09	20	—0.11	13	0.10	16
1922	0.19	12	0.05	14	− 0.02	13	—0.03	11	0.12	5	0.24	2	—	—	—	—	0.01	7	0.01	'6	−0.02	16	0.02	16
1923	0.00	15	—0.01	13	—0.09	27	—0.45	8	0.00	12	—0.11	19	0.19	6	0.07	26	0.00	30	0.13	24	0.03	53	0.11	22
1924	0.03	8	0.00	7	0.03	20	—0.05	12	0.03	22	—0.07	28	0.08	26	0.02	30	− 0.08	39	− 0.09	22	—0.06	21	—0.05	32
1925	0.12	17	0.12	22	0.15	17	0.07	16	0.12	23	0.23	21	0.21	23	0.21	23	0.12	30	—0.01	40	− 0.14	42	0.07	22
1926	- 0.03	25	- 0.04	21	—0.03	36	0.01	31	0.02	14	0.07	14	0.06	32	0.16	21	0.05	23	0.03	27	0.06	23	− 0.02	18
1927	0.05	21	0.00	21	− 0.10	21	—0.03	23	0.15	21	0.14	14	0.01	80	0.06	22	—0.06	34	0.08	37	—0.01	31	—0.18	34
1928	—0.17	29	0.02	32	—0.06	31	−0.12	32	−0.16	70	—0.15	53	0.00	41	0.04	34	—0.09	25	—0.05	42	—0.08	35	− 0.09	44
1929	− 0.08	33	− 0.10	35	—0.15	42	—0.14	35	—0.09	40	—0.03	57	0.17	34	0.11	39	0.11	36	—0.01	148	0.08	39	0.10	41
1930	0.20	33	0.09	37	0.00	41	0.00	29	0.04	36	0.02	41	0.08	34	0.06	40	− 0.02	34	—0.06	65	—0.07	42	—0.08	35
1931	—0.09	35	—0.07	36	− 0.01	31	−0.12	50	− 0.05	43	—0.05	38	0.06	35	− 0.12	41	—0.11	31	0.01	56	—0.07	38	—0.05	33
1932	− 0.02	32	− 0.09	32	—0.09	34	−0.13	42	—0.08	53	− 0.07	42	0.02	46	—0.07	36	—0.07	36	− 0.02	57	—0.01	39	0.00	37
1933	—0.03	33	− 0.03	35	− 0.02	35	− 0.03	46	0.08	50	0.05	48	0.06	50	0.13	48	0.14	56	0.06	54	0.09	32	0.11	33
1934	0.07	27	0.04	24	0.03	33	0.04	32	0.07	37	0.11	63	0.12	76	0.07	41	0.06	52	—0.01	48	0.15	47	0.14	29
1935	0.04	54	0.08	26	0.09	33	0.10	61	0.13	42	0.13	34	0.17	27	0.15	60	0.09	27	0.00	70	—0.05	72	—0.20	27
1936	0.09	25	—0.03	153	0.02	28	—0.07	30	—0.07	58	0.01	29	0.04	27	0.02	57	0.01	35	0.06	69	0.06	68	0.19	22
1937	0.14	31	0.00	35	—0.05	31	—0.04	26	—0.04	43	- 0.06	50	0.04	47	0.08	42	− 0.04	29	0.07	65	0.01	53	0.03	33
1938	0.08	31	0.03	37	0.04	27	0.05	31	0.01	39	0.10	26	0.04	32	0.04	29	—0.01	37	0.00	41	0.04	34	0.18	31
1939	0.11	23	0.06	31	—0.01	3	0.06	24	0.06	30	0.05	31	0.10	28	0.13	37	—		—	—	—	—	—	—
1946	—	—	—	—	—	—	—	—	—0.22	12	—	—	0.00	10	—0.18	2	—0.19	3	—0.08	2	0.02	2	0.00	2
1947	0.06	3	—0.09	29	—0.08	16	—0.02	2	—0.15	67	—0.02	18	—0.11	24	—0.10	22	− 0.23	20	− 0.19	15	− 0.13	28	- 0.03	13
1948	0.18	10	−0.30	2	− 0.32	24	0.22	25	0.12	61	- 0.15	36	—0.05	32	- 0.16	32	− 0.14	49	—0.11	36	0.12	27	− 0.08	26
1949	- 0.03	44	0.09	52	0.01	43	0.08	65	0.12	38	0.10	36	0.20	23	0.11	32	0.09	36	0.09	30	- 0.05	29	0.02	30
1950	—0.05	24	—0.07	42	0.04	30	0.01	39	0.03	27	0.11	35	0.05	43	0.00	36	0.10	34	0.07	24	0.09	20	— 0.06	32

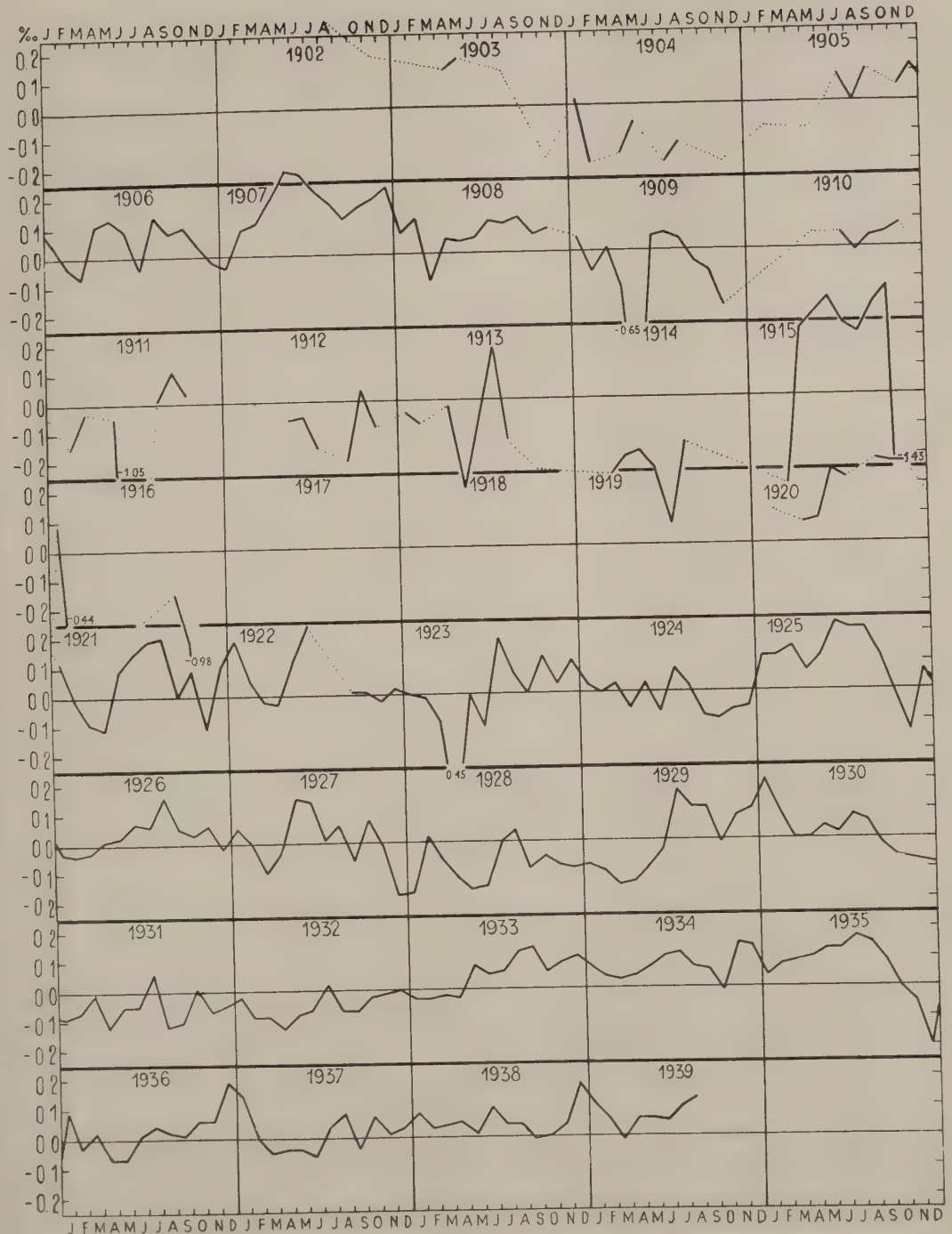


Figure 2. Monthly anomalies of the surface salinity in the area G (see Fig. 1) during the period 1902—39.

Table 3. Yearly Averages of the Monthly Anomalies of Surface Salinity (‰) in Area G.

1902	0.20	1917	—	1932	—0.05
1903	0.06	1918	—	1933	0.06
1904	—0.14	1919	—	1934	0.08
1905	0.03	1920	0.19	1935	0.06
1906	0.06	1921	0.06	1936	0.01
1907	0.17	1922	0.04	1937	0.01
1908	0.08	1923	0.01	1938	0.05
1909	—0.04	1924	—0.02	1939	0.08
1910	0.02	1925	0.08		
1911	—0.26	1926	0.02	1946	—0.11
1912	—0.09	1927	0.00	1947	—0.12
1913	—0.18	1928	—0.08	1948	—0.14
1914	—0.21	1929	—0.01	1949	0.04
1915	0.15	1930	0.01	1950	—0.02
1916	—0.24	1931	—0.05		

The result of the calculations is given in Table 2 where the anomalies of the several months are recorded together with the number of observations on which they are based. A graphical presentation of the data up to 1939 is shown in Figure 2.

It is seen that positive anomalies predominate in the period 1933—39, negative anomalies in post-war years. These features appear even more conspicuously from Table 3 which gives yearly averages of the monthly means of anomalies (weighted by the relevant number of observations) recorded in Table 2.

Thanks are due to Mrs. Holm and Mr. P. Alnøe who have carried out the calculations.

Jens Smed.

THE FISH

The Demersal Species.

The Dutch Fishery for Demersal Sea-Fish in 1950.

The Dutch figures of the North Sea demersal fisheries in 1950 indicate that the overall decline in the fish stock that could be observed during the period 1945—1949 has not been continued in 1950.

Table 4 shows the total landings and their composition at IJmuiden.

The total weight landed has increased as compared with 1949, and was this year of the same order as in 1947. The landings of cod remained at about the same level as in 1949. The returns of haddock and plaice both have increased, as the result of a considerable rise in the smallest market category. On the other hand the landings of larger haddock and plaice decreased.

The landings of soles have nearly doubled, mainly due to bigger catches of small soles.

The landings of other fish except turbot and whiting have decreased.

The figures of den Helder (Table 8) give nearly the same picture. Table 7 gives the percentages of fish belonging to the class "small".

Table 5 shows the number of days absence, the quantity landed and the catch per days absence of the steam trawlers. The mean catch per days absence has increased considerably as compared with 1949. This rise is wholly due to the still increasing mean fishing capacity of the steam trawlers. Some new, larger trawlers have been added to the fleet, whereas many smaller ones have been laid up. If we calculate the mean catch per days absence of the imaginary standard ship in the same way as it has been done in the previous paper, we get the result given in Figure 3. This figure shows that the density of the fish stock has remained nearly constant since 1949.

The graph of the catch per days absence of the Dutch cutters shows a small rise since 1949 (Fig. 4).

Table 6 gives the mean catch of the different fish species per 100 hours fishing of the steam trawlers. We had no opportunity to calculate these data for the standard ship. They are consequently not quite comparable with those of 1949. But we still can get an impression of

Table 4. Quantities (in tons) of Demersal Fish landed in 1950 at the Port of IJmuiden.

Species	Market categories.	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		11.6	27.1	9.0	4.6	52.3
Cod	Large	371.0	332.8	327.9	155.3	1,187.1
	Medium	59.3	76.1	171.6	74.5	381.5
	Small	143.3	225.4	219.7	166.2	754.6
	Total	573.5	634.3	719.3	396.0	2,323.1
Dab		473.4	259.2	95.6	171.4	999.6
Flounder		162.2	28.7	30.9	12.2	234.0
Gurnard and Latchet		87.1	244.1	43.6	84.3	459.1
Haddock	Large	50.5	76.6	44.3	68.3	239.7
	Medium	69.4	151.4	338.0	345.2	903.9
	Small	281.6	516.1	744.0	1,229.6	2,771.3
	Total	401.4	744.1	1,126.3	1,643.0	3,914.9
Hake		40.5	61.6	38.3	26.2	166.6
Ling		40.9	29.4	18.5	36.2	125.0
Plaice	Large	272.6	113.0	118.2	48.6	552.4
	Medium	418.0	270.9	205.9	61.8	956.6
	Small	1,267.0	1,928.1	1,638.5	1,097.0	5,930.7
	Total	1,957.6	2,312.0	1,962.7	1,207.4	7,439.7
Saithe		472.8	294.2	162.3	324.3	1,253.6
Sole	Large	76.4	56.2	29.6	40.9	203.1
	Large medium	71.7	80.4	53.4	120.0	325.5
	Small medium	64.5	60.4	154.0	415.1	694.0
	Small	621.2	426.5	326.3	689.8	2,063.8
	Total	833.8	623.5	563.3	1,265.8	3,286.4
Turbot		82.7	166.5	110.0	118.5	477.7
Whiting		1,103.7	613.8	878.4	809.7	3,405.6
Other species		235.3	247.6	92.2	135.0	710.1
Total		6,476.5	6,286.1	5,850.4	6,234.6	24,847.7

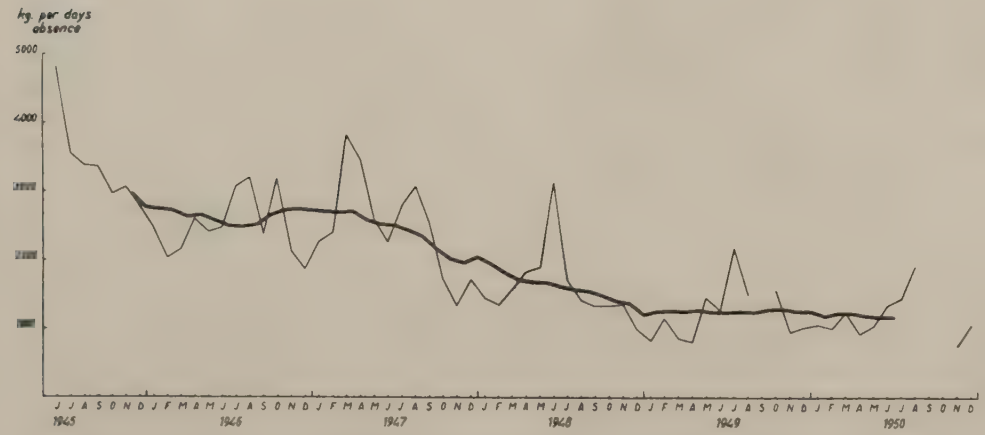


Figure 3. Mean catch per days absence, with moving average calculated over periods of 12 months, of a Dutch standard steam trawler (see text).

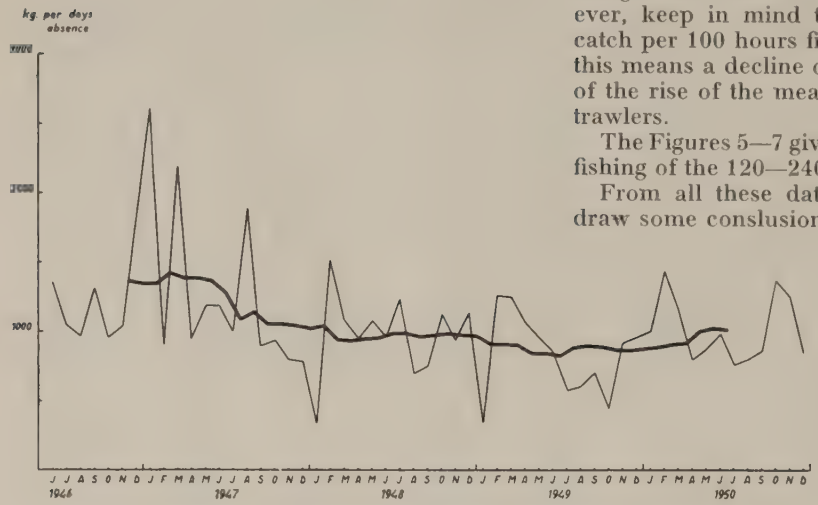


Figure 4. Mean catch per days absence by Dutch cutters, with moving average.

the general course of affairs. We must, however, keep in mind that if we see the same catch per 100 hours fishing in 1950 as in 1949 this means a decline of the fish stock, because of the rise of the mean fishing-capacity of the trawlers.

The Figures 5—7 give the catch per 100 hours fishing of the 120—240 H. P. motor-cutters.

From all these data together we now can draw some conslusions about the fish species.

The trawlers show a rise in the small **cod,** and some decline in the big ones. The cutters (Fig. 5) show a small decline in all categories of cod. The general impression is that this species did not change very much.

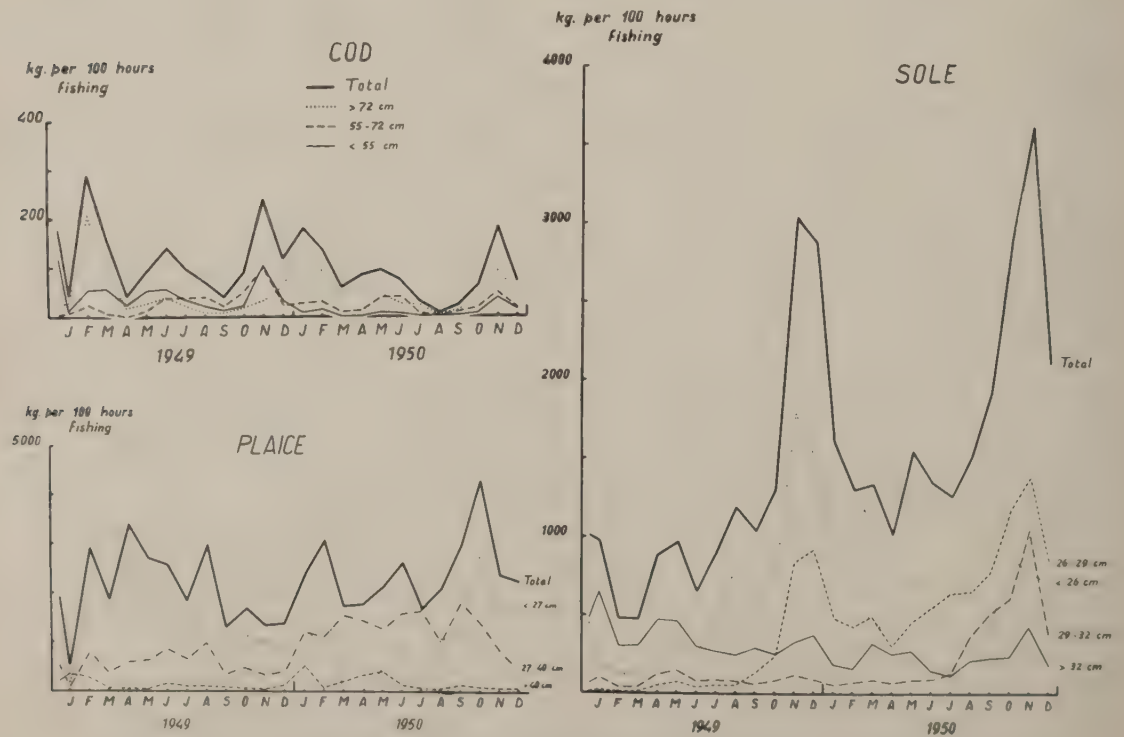


Figure 5—7. Catch per 100 hours fishing of Dutch cutters.

Table 5. Catches of Steam Trawlers fishing from the Port of IJmuiden in 1950.

Month	No. of days absence	Quantity landed (tons)	Quantity per days absence (kg.)
January	62	126.5	2,040
February	95	189.1	1,990
March	66	124.3	1,883
April	37	50.5	1,366
May	106	219.7	2,073
June	53	133.0	2,510
July	54	126.1	2,336
August	16	52.6	3,288
September	0	0	—
October	0	0	—
November	24	53.7	2,238
December	164	402.6	2,455
Total year	677	1,478.2	2,183

The density of the small **haddock** has risen considerably according to Table 6, but the larger ones have again decreased. Presumably a rather good new year-class has grown into the fishery.

The catch per 100 hours fishing of **plaice** and **soles** by the steam trawlers has decreased, so far that hardly any sole have been landed.

Table 6. Mean Catch (in kg.) per 100 hours fishing of Steam Trawlers at IJmuiden in 1950.

	Cod kg.	Haddock kg.	Plaice kg.	Sole kg.
Large	1,586	353	49	0
Medium	246	970	128	0
Small	898	3,815	61	0
Total	2,730	5,138	238	0

The same figures of the cutters show quite another picture. Their catch of plaice per 100 hours fishing (Fig. 6) has only slightly increased, especially in the smaller categories and in the last part of the year. These figures are not in accordance with the total landings of

Table 7. The Landings of the Class "Small" in 1950.

(Expressed in cm. as a percentage of the total.)

Quarter	A. IJmuiden					B. Den Helder
	Cod	Haddock		Plaice		Plaice
	$< \pm 72$	$< \pm 44$	$< \pm 30$	$< \pm 40$	$< \pm 27$	$< \pm 40$
1st	35	87	70	86	65	95
2nd	48	90	69	95	83	97
3rd	54	96	66	94	83	98
4th	61	96	75	96	91	98
1950	49	94	71	93	80	97
1949	43	90	61	91	63	95

Table 8. Quantities (in tons) of Demersal Fish landed in 1950 at the Port of den Helder.

Species	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill	2.6	4.6	1.4	—	8.6
Cod	10.8	3.7	1.1	3.1	18.7
Dab	53.7	36.7	10.5	10.0	110.9
Flounder	19.7	7.5	5.4	6.1	38.7
Plaice Large	5.9	4.5	4.9	1.8	17.1
Medium	34.8	53.2	56.4	25.5	169.9
Small	89.0	139.8	154.2	101.9	484.9
Total	129.7	197.5	215.5	129.2	671.9
Sole	63.5	78.0	72.3	95.6	309.4
Turbot	3.0	11.5	9.5	7.3	31.3
Whiting	89.6	41.3	32.1	72.6	235.6
Other species	3.7	3.6	1.8	1.5	10.6
Total	376.3	384.4	349.6	325.4	1,435.7

plaice at IJmuiden, which show an important rise in the small fish and a decline in the large ones. The big rise in the landings of small plaice appears to be due to a relative increase in the total activity of the smaller vessels fishing nearer to the coast. The trawlers went fishing for roundfish especially and therefore caught few flatfish. The cutter figures will give the most reliable picture of the course of the plaice stock.

The same applies for the **sole.** Fig. 7 shows that the increase of the catch per 100 hours fishing of the cutters has continued.

The catch per unit of time is of the same order now as it was shortly after the war. All this will have been the effect of one very strong year-class, 1947. This year-class caused a rise in the catches of the smallest market category ($<$ 26 cm.) from the winter 1948/49 until about June 1950, after which a drop followed. The catches of the next market category (26—29 cm.) rose from about October 1949 until December 1950 and the category 29—32 cm. rose since July 1950.

It now looks fairly probable that the decline in the catches of soles from 1945 until 1949 has mainly been caused by a series of poor year-classes and not only by a too intensive fishery.

L. K. Boerema.

Plaice.

Occurrence of 0-Group Plaice in the Danish Waddensea.

During several years the abundance of 0-group plaice in the Danish Waddensea off south-west Jutland has been recorded by chartered motorboats (cf. Ann. Biol. Vol. 1, 1943

and Vol. 2, 1947). The gear used is the young-plaice-trawl and during most years the research has been carried out 3—4 times during the months June to November. According to our experiences the best season for these investigations is the autumn months September and October, which give the most reliable survey of the strength of the year-class of small plaice.

Table 9. Number of 0-Group Plaice caught with young-fish-trawl in the Danish Waddensea.

June-November 1935—1950.

Year	Number of hauls à 15 min.	Number of 0-group plaice	Number per hour	Deviation from average number per hour for 1935—1950.	
1935	34	1281	151	—	58
1936	60	4161	277	68	—
1937	26	2706	416	207	—
1938	21	373	71	—	138
1939	14	1233	352	143	—
1940	41	2342	228	19	—
1941	44	2576	234	25	—
1942	44	446	41	—	168
1943	27	1189	176	—	33
1944	14	259	74	—	135
1945	54	2844	211	2	—
1946	50	4996	400	191	—
1947	41	1614	157	—	52
1948	54	127	9	—	200
1949	10	396	158	—	51
1950	43	4116	382	173	—
Average	36	1916	209	—	—

Table 9 shows that the predominant year-classes in the area investigated have been 1937, 1939, 1946 and 1950. The three first mentioned year-classes have predominated in the North Sea plaice fishery, but some few year-classes, not especially rich according to the present review of 0-group plaice in the Danish Waddensea, have however also been of importance to the fishery (e.g. 1947). It is accordingly likely that the young bottom stages of some 0-groups have been carried by the current predominantly to the more southerly parts of the Waddensea along the southern coast of the North Sea. It is therefore of importance that a general review should be obtained by international co-operation from all Waddensea areas from Holland to the Horns Reef area and England as well.

Å. Vedel Tåning.

The Stock of Plaice in the Horns Reef Area.

Quantitative fishing experiments at 21 stations in the southern Horns Reef area (see Table 10) showed that the density of the stock was about 25% as great as in the period 1934—37, when fishing was carried out at the same season. The V-group (1945 year-class) and older plaice were very scarce, the IV-group (1946 year-class) was considerably more numerous than normal, the III-group (1947 year-class) was still richer but the 1948 year-class was normal and the 1949 year-class poorer than normal. From marking experiments and changes from year to year in the relative frequency of the year-classes we know that the Danish plaice fishery takes many plaice which have grown up in more southerly parts of the plaice nursery grounds. The German investigations, which were restarted in 1948 and have been carried out twice a year, show that the 1947 year-class was also very rich in the more southerly areas, and that the 1948 year-class there was richer than the 1944, 1945, and 1946 year-classes. In these areas the 1944 and 1945 year-class seem to have been below normal, whereas it is doubtful whether the 1946 year-class was above normal[1]).

Table 10. Number of Plaice caught per hour in the southern Horns Reef area, in June 1950, compared with mean for the previous years (June 1934—37, May-June and August 1938 and July 1939).

50-foot otter-trawl, 10—30 m. depth.

Length-groups between 5 and 35 cm.

cm.	5–9	10–14	15–19	20–24	25–29	30–34	Total
1934–39	84	130	98	48	13	1	374
1950	14	79	250	93	26	2	464

Age-groups I—VII+

	I	II	III	IV	V	VI	VII+
1934–39	132	150	53	14	10	15	2
1950	25	109	284	45	2	—	—

The average lengths of the various age-groups were about the same as in 1934—37, i.e. the growth was rather good.

Aage J. C. Jensen.

[1]) A. Kotthaus: Kontrolle des Schollenbestandes der Deutschen Bucht im Jahre 1949. Ber. Deutsch. Komm. Meeresforsch., N. F., Bd. XII, Hft. 1, 1950.

Table 11. Length Distribution of Plaice (%) in Danish catches in 1950 and previous years.

Area	Year	Month	Depth, m.	No. St.	Length in cm. 27–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70
S. Horns Reef	1948	V—VI	20	2	70	30	—	—	—	—	—	—	—
— Slugen	1950	V	19	1	86	14	—	—	—	—	—	—	—
W. of Horns Reef	1949	VIII	34	2	74	24	2	—	—	—	—	—	—
	1950	VIII	41	1	98	2	—	—	—	—	—	—	—
Between Horns Reef	1948	X—XI	38	2	88	10	2	—	—	—	—	—	—
and Clay Deep	1949	X	41	1	80	17	3	—	—	—	—	—	—
	1950	X	41	1	88	11	1	0.1	—	—	—	—	—
Between Tailend	1948	VIII–IX	50	1	68	28	3	0.4	0.5	0.2	0.1	—	—
and Clay Deep	1950	VIII	44	3	77	19	2	1	0.2	0.1	—	—	—
	1948	X—XI	50	1	36	43	16	2	1	1	—	—	—
	1950	X	47	3	61	32	6	1	0.1	0.1	0.1	—	0.1
Clay Deep	1948	VIII—IX	52	1	38	46	11	4	1	0.2	0.2	—	—
	1950	VIII	44	3	35	38	22	4	0.4	0.3	0.2	—	—
Dogger Bank N. E.	1948	V—VI	27	1	32	57	9	1	1	0.1	—	—	—
	1950	V	34	1	23	24	36	16	1	—	—	—	—
Dogger Bank South	1948	VIII—IX	23	4	40	32	13	3	2	0.1	—	—	—
	1950	VIII	37	1	29	53	15	2	0.2	0.4	0.2	—	—
Dogger Bank N. W.	1948	VIII—IX	36	1	14	29	49	6	2	—	—	—	—
	1950	VIII	38	1	6	32	40	12	2	6	1	0.4	—

The Danish Plaice Fishery.

The market investigations at Esbjerg carried out by Dr. TÅNING's department of "Kommissionen for Danmarks Fiskeri- og Havundersøgelser" make possible a comparison between the catches in 1950 and previous years.

Density of the Stock.

The mean weight per landing in tons from the most important Danish fishing grounds was as follows (number of landings in brackets, map of areas in Ann. Biol. IV, p. 101):—

	1948 March-Oct.	1949 March-Aug.	1950 May-Oct.
C2, north-eastern	2.9 (6)	2.7 (8) 3.5 (9)	2.9 (21)
C2, western	2.3 (3)	3.0 (4)	3.9 (6)
Dogger Bank	2.1 (17)	2.4 (5)	2.7 (5)

The mean value 2.7 tons for C2, north-eastern in 1949 was calculated by excluding an extraordinary large landing (10.5 tons). Between the Horns Reef area and the Tailend the density was, in 1950, about the same as in 1949. On the Dogger Bank and south-east of the Dogger the density seems to have increased. Yet the density was not satisfactorily great as was indicated by many of the cutters on each trip fishing on many different grounds.

Length Composition of Catches.

From Table 11 it is seen that the average length of the plaice landed from the grounds between Esbjerg and Clay Deep has diminished during the last two years, but has increased W. of Clay Deep and on the Dogger.

Age Composition.

The decline of the average length of the commercial plaice on the eastern grounds must be explained by the fact that the plaice caught were on the whole younger in 1950 than in 1949, the IV-group, the rich 1946 year-class being very dominant. To the west of Clay Deep older age-groups were more abundant in the catches in 1950 (cp. Table 12).

Table 12. Age Distribution (%).

	E. of Clay Deep 1949 August	E. of Clay Deep 1950 August	W. of Clay Deep 1948 Oct.-Nov.	W. of Clay Deep 1950 Oct.-Nov.	1950 August
N. Lat.	54°56′	55°22′	55°34′	55°22′	55°20′
E. Long.	6°40′	6°12′	5°37′	5°04′	4°35′
Depth, m.	43	51	55	45	44
Age-group					
II	—	—	24	—	—
III	12	5	51	16	2
IV	44	71	20	78	48
V	28	22	5	5	37
VI	6	2	—	—	11
VII	3	—	—	—	2
VIII	2	—	—	—	0.3
IX	2	—	—	—	0.03
X+	3	—	—	—	0.1

AAGE J. C. JENSEN.

The Sex-Ratio of Plaice and the Effect of Fishing.

As long ago as the end of the first world-war WALLACE[1]) found indications of an increase in the proportion of male plaice on certain comparable grounds in the southern North Sea, the proportion of male plaice being in excess of the pre-war value in six out of nine cases.

The further extensive reduction of fishing in the second world-war and the records available since 1920 afford a more massive material for the study of the sex-ratio of plaice from the British steam trawler catch in the North Sea, and it is also possible to examine the sex-ratio of an inshore plaice fishery in Rye Bay under different fishing efforts between 1942 and 1950.

Up to 1931 the material for the open North Sea is drawn from length measurements made on trawlers at sea, but afterwards they are based on samples taken for age-determination and length measurements on the fish markets at Grimsby and Lowestoft. In Table 13 below some of these years are given. From 1931 onwards the age-determination material is employed, the original figures being raised to an estimate of the total catch for the four special months used for sampling. The table also shows the catch per day's absence and the number of days absence per year.

Table 13.

Year	% Males	Days absence per year in 1000 s	Catch per day's absence (cwt.)
1920	52.2	163.6	3.6
1924	50.6	132.4	2.4
1928	45.6	129.9	2.6
1931	47.8	121.2	2.6
1932	50.3	114.0	2.4
1933	47.4	126.6	2.5
1934	48.2	135.0	2.5
1935	45.5	122.9	2.4
1936	46.8	115.1	2.6
1937	39.0	107.9	2.6
1938	44.3	94.3	2.5
1946	51.7	60.1	8.4
1947	50.6	61.0	6.5
1948	46.3	59.3	5.6
1949	48.8	53.5	4.8

These figures show how the proportion of males fell away after the first world-war and how it had risen by the end of the second during which the fishing effort had been lifted from the stock.

[1]) WALLACE W. In BORLEY J. O., and collaborators. Ministry of Agriculture and Fisheries, Fish. Invest. Ser. II, Vol. V, No. 3, p. 29. 1923.

That the differences between pre-war and post-war years are not substantially affected by the distribution of the year-classes is shown by the separate age-groups II—XI+ from the Grimsby and Lowestoft trawler landings from 1931—38 given in Table 14. This table gives the percentage males in each age-group estimated from raised age-determination samples taken in the same months each year.

Table 14.

Year	% Males in Age-Groups										
	II	III	IV	V	VI	VII	VIII	IX	X	XI	All
1931	55.6	52.2	52.6	54.1	41.1	37.1	30.7	21.6	9.7	4.5	47.8
1932	58.1	55.6	55.4	50.9	44.0	37.8	33.3	23.5	13.4	1.8	50.3
1933	37.1	42.8	53.6	52.0	45.4	38.3	30.1	25.2	14.1	3.8	47.4
1934	51.3	43.2	47.2	57.7	51.5	35.3	33.2	20.2	19.2	5.4	48.2
1935	32.8	44.4	48.4	46.0	58.7	43.4	22.8	23.5	15.3	5.0	45.5
1936	33.9	43.4	48.8	53.1	51.7	46.6	44.9	16.3	10.3	3.1	46.8
1937	30.9	42.9	42.5	36.8	38.5	35.5	29.5	21.4	10.0	3.7	39.0
1938	47.8	46.8	47.8	44.1	41.2	41.8	39.7	26.5	23.2	1.7	44.3
1946	63.9	66.4	56.1	61.1	62.3	52.2	43.5	40.2	36.9	25.8	51.7
1947	57.7	56.2	56.9	55.8	50.4	51.9	33.9	25.6	18.9	10.6	50.6
1948	55.9	49.6	52.2	46.8	48.7	38.8	28.7	13.5	6.7	6.7	46.3
1949	41.1	48.8	52.0	58.0	37.7	59.7	67.0	36.8	17.1	5.8	48.8

Naturally the numbers in each sample are much smaller than those for the year, nevertheless, in those age-groups which are most abundant — II to V — it is seen that there has been a decline in the proportion of males in the years before the last war, a recovery in all age-groups after the war and another decline in age-groups II to V in the years since the war.

The size-distribution might be thought to have some effect on the sex-ratio as one would expect to find more females among the bigger fish. In Table 15 I have arranged the considerable numbers of length measurements made on British 1st class steam trawlers in 1920, 1924, 1928 and 1931 and on Grimsby and Lowestoft fishmarkets for 1946—49 in 5-cm. groups between 20 and 49 cm. These groups were sampled throughout each year and were generally of several thousand fish. Unfortunately, between 1931 and 1938 measurements

Table 15.

Year	% Males in 5-cm. Length-Groups						
	20—24	25—29	30—34	35—39	40—44	45—49	All
1920	59.1	59.2	64.2	56.0	33.3	13.4	52.2
1924	62.0	55.0	52.9	42.3	24.0	7.0	50.6
1928	61.4	52.7	47.5	30.6	15.8	3.3	45.6
1931	57.9	54.4	49.5	35.5	13.9	1.7	43.9
1946	69.2	67.6	74.8	50.9	23.5	5.2	56.5
1947	65.7	62.2	65.4	59.2	26.2	5.6	56.7
1948	66.9	58.2	53.0	58.3	31.6	8.5	53.4
1949	64.7	56.6	52.1	51.1	26.3	5.2	50.8

are only available for the four months of the year when age determinations were made and for this reason I cannot give comparable information in this period.

The table shows that for most of the length-groups there was a fall in the proportion of males from 1920 to 1931 and a rise after the war in 1946. The course of the ratio between 1946 and 1949 is a little curious. The three smaller length-groups show a tendency for the ratio to fall, but in the 35—39 cm. group the highest proportion of males is not reached until 1947 and in the two highest length-groups the maximum is not reached until 1948. The total figure for these data shows a slight increase from 1946 to 1947 and thereafter a decline.

As the location of the British trawl fishery was somewhat restricted by mine fields just after the war and as it spread eastwards as these fields were cleared, it seemed possible that there might have been a regional effect on the sex-ratio of plaice and a higher proportion of males found in 1946 because the fishery would have been more concentrated upon the spawning ground area where males would be expected to be in greater excess than elsewhere. To test this I examined the percentage of males from one of the statistical rectangles that was best sampled for market length measurements throughout most of the months of each year—G. 4. The results are given here in Table 16 and show the same tendency to decline from a high value in 1946 to a lower one in 1949 that was shown in the previous figures.

Table 16.

Year	1946	1947	1948	1949
% Males	58.9	58.5	50.4	52.8
Number of fish measured	11,615	10,209	11,063	9,953

It appears, therefore, that there has been a real increase in the proportion of males caught in the British deep sea trawl fishery since the war. The increase of the proportion of males among the larger fish from 1946 to 1948 appears to have been substantial but cannot yet be explained.

The position in the inshore fishery at Rye Bay is quite the opposite of that in the deep sea fishery just mentioned. From this inshore area there are available the percentage of males based on the numbers of plaice caught per hundred hours absence from port for the brood-years 1942/43 to 1949/50, together with the corresponding catch in cwt. per hundred hours absence from port of the recorded motor trawlers and the annual fishing time. These figures are given in Table 17 (p. 96) which also shows the proportion of males for the important II- and III-group fish.

In this case it will be seen that the proportion of males was lowest where the catch per hundred hours' absence indicates stock accumulation as a result of the war-time relaxation of fishing and that as fishing effort increased again it was the females that declined, not the males as appeared to be the case in deeper waters. From this it seems that the incidence of fishing in this inshore area was heavier on the females than the males.

The observations on the Rye Bay plaice fishery that have been made since 1942 show

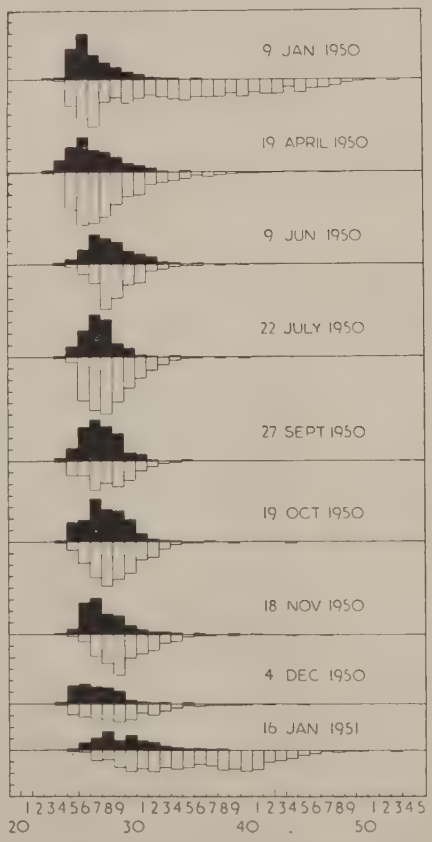


Figure 8. Histograms black for males and white for females showing the size distribution of motor trawler samples of Rye Bay plaice in various months between January, 1950 and January, 1951. The ordinate is marked in 20 s and the abscissa gives the length in centimetres.

Table 17.

Brood year	% Males II-group	% Males III-group	All	Hours absence in 1000 hours	Catch per 100 hours absence in cwt.
1942/43	51.1	47.8	36.2	47.1	25.6
1943/44	36.6	44.7	29.6	59.8	23.0
1944/45	40.9	31.2	26.7	66.0	31.4
1945/46	42.0	37.4	36.0	80.9	22.3
1946/47	50.7	48.8	48.1	55.3	13.1
1947/48	43.1	46.0	43.1	56.4	12.8
1948/49	47.6	50.4	47.6	53.2	14.3
1949/50	41.2	44.9	41.2	36.8	12.1

that females are always more important than males considering the year as a whole. The seasonal picture of length measurements for samples taken between January 1950 and January 1951 is given in Figure 8. It shows that females were dominant in all the measured samples taken except that of September 1950, and that in January a group of large females appears in the catches but has gone by April and was little in evidence in December. These are mature fish and in January 1951 three-quarters of those examined were spent spawners. It seems likely then, that these inshore grounds are populated preferentially by females generally, but that they are the particular resort of large spent females in the winter.

R. S. Wimpenny.

Dab.

The Stock of Dab in the Horns Reef Area.

The stock of dab was also investigated in the quantitative fishing experiments (see plaice

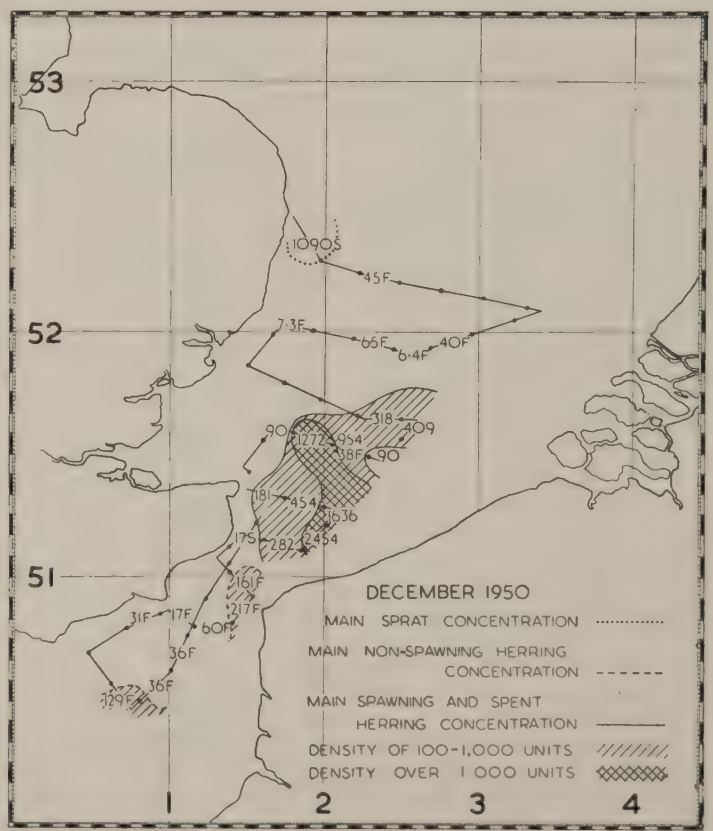


Figure 9. Chart of echo-sounder survey 8th—12th December 1950. The cruise of the ship is shown divided into ten mile stretches. The measurements of fish tracing per ten miles distance are shown. The tracings have been divided into three categories: S following the number denotes sprat shoals, F following the number denotes non-spawning herrings or pilchards, and the numeral by itself without any following letter denotes spawning herrings.

p. 92). The density and length-distribution were about the same as in the years before the war, yet there were twice as many of lengths 20—25 cm., i.e., a little below the Danish minimum length for commercial dab, than there were on the average in the years 1934—37.

AAGE J. C. JENSEN.

Sprat.

Echo-Sounder Surveys for Sprats in 1950-51 Season.

In the *Annales Biologiques*, Vol. VI, 1949 (1950), an account of the use of the echo-sounder for charting concentrations of sprats, was given. The method used for working up such surveys was referred to briefly and closely follows the method developed by D. H. CUSHING off the Northumberland coast and which is described by him in a paper which is still in the press.

It was hoped to arrange a series of cruises in the southern North Sea from December onwards in order to follow the movements of the sprat concentrations, but unfortunately only two of the surveys were actually completed. Both of these are included in this paper.

In each case the sounder paper was divided into sections representing ten miles of the ship's course. The fish traces which were recorded were measured and these measurements were plotted in the appropriate position on the chart. The two surveys were carried out on different machines, therefore the measurements are not strictly comparable between cruises.

Three types of fish trace were recorded on the December cruise shown in Figure 9. The rarest type was the "comet" shaped tracing associated with sprats and this type was found in an area off Lowestoft and also off the South

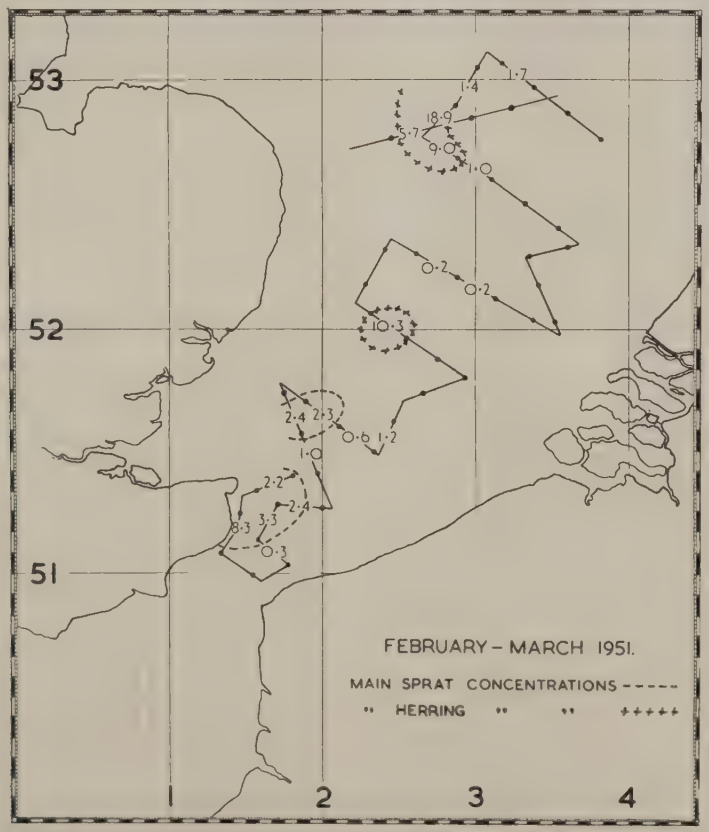


Figure 10. Echo-sounder survey February—March 1951 showing concentrations of sprats and herrings.

Foreland. The remaining tracings could be divided into two groups, one of which was very diffuse while the other was clearer and well defined. The former is usually associated with spawning fish and the latter with non-spawning, often full, herrings or pilchards.

In Figure 9, these two categories are shown. The spawning fish are represented by numerals only, whilst the second group has the numeral followed by the letter F denoting full fish or non-spawning fish. When plotted the spawning fish occupy the central area extending from the Sandettié and Fairy Banks to the North Falls. North of this area the fish were in much smaller quantities and were full or non-spawning fish. Further south off Cap Gris Nez and down the English Channel there was an area of tracings of the full herring or pilchard type. This survey revealed only small concentrations of sprats, but on the February-March survey shown in Figure 10, a larger area of sprats was found off the Kent coast and another area had appeared farther north around the North Falls. Two patches of herring were also found and are shown in the figure. These shoals were compact and similar to those described as non-spawning herring in the previous cruise.

A most notable feature is the agreement between the areas in which the sprat and herring concentrations were found on this survey (Figure 10) with those found on the January survey of 1950, described in Vol. VI of the Annales. Although the 1950 survey was carried out six weeks earlier than the 1951 survey, two concentrations of sprats and two concentrations of herring were found on each survey in approximately the same areas. The only concentration which is not shown in the 1951 survey is one of sprats off the Dutch coast and this was because the 1951 survey did not cover this area.

The quantity of sprats landed at the SE. coast ports during 1950 shows no substantial increase when compared with the previous year as the following figures show:—

Landings of Sprats in cwt.

	Thames	East Anglia	Kent
1949	17,841	1,346	466
1950	18,202	2,395	3,184

The Larsen trawl which was used in the Thames for the first time contributed considerably to the total landings, but even so, the stow-boat catches continued to remain small and well below the pre-war level.

The large quantities of herring found on the December cruise were not found in the later survey shown in Figure 10, but this was probably due to the lack of coverage on the eastern side of the southern North Sea along which the spent herring might have moved.

I. D. Richardson.

Transition Area.

INTRODUCTION

Contributions to this report have been received from Dr. Alf Dannevig, Dr. Aage J. C. Jensen, Cand. mag. I. Bohus Jensen, Cand. mag. J. B. Kirkegaard, Cand. mag. J. Knudsen, Dr. Arvid R. Molander, Dr. Erik M. Poulsen, and Mag. Helge Thomsen.

A. Environment.

Hydrography. In the Kattegat and in the Belt Sea in the autumn of 1949 the salinity of the surface water was high: between October and December the temperature was considerably above normal. In the spring, 1950, the temperature was above normal (see Tab. 2) and this coincided with the production of a large amount of cod larvae in the same year.

Off the Norwegian Skagerak coast the temperature near the surface was fairly high throughout the period January-November 1950.

Benthic Food. Valuations of the sea-bottom were carried out in the Limfjord, the Kattegat and the Belt Sea. In the Limfjord the quantity of fish food was rather low, whereas the quantity of such larger animals as Mytilus and Ascidiella was, as in previous years, high.

B. Fish.

Eggs and Larvae.

Investigations with the ring-trawl in Danish waters from February to May showed a rich abundance of cod larvae in all seas. In the S. Kattegat, few larvae of haddock and whiting were found. The number of flounder larvae was, as in the previous year, large, but dab larvae were scarce. The number of plaice larvae was below normal in April and above normal in May.

Older Fish.

Cod. Following the rich abundance of larvae, the bottom stages of the 0-group were caught in the Danish waters in large quantities during the summer and autumn. Two rich year-classes (1949 and 1950) are now growing up in the Danish seas.

The numbers of bottom stages were also above the normal along the Norwegian Skagerak coast.

Whiting. A big stock of young whiting (0- and I-gr.) was found in the Danish seas. Thus there is nothing at present to indicate that the heavy fishing of young whiting for the waste-fish industry has endangered the stock.

Plaice. Only along the western coast of the northern Kattegat was the 0-group observed to be rich. Elsewhere it was about normal (Belt Sea, western Baltic and Sound) or below normal (southern and central Kattegat). In some places in the Belt Sea a comparatively rich occurrence of the 0-group was observed in deeper water (10—20 m.). Obviously the occurrence in these deeper waters must also be considered in order to get a true picture of the full strength of the 0-group.

In the western part of the Limfjord the stock was the lowest ever observed in the period 1926—50.

As usual, transplantations from the western Limfjord to the central Limfjord and to the Belt Sea and adjacent waters were carried out.

Dab. In the Limfjord the dab stock was, just like the plaice stock, the smallest ever found in the period 1926—50. The growth of both the dab and the plaice was accordingly comparatively strong.

In the inner Danish waters the stock was far below the normal for the years 1930—39.

Fish for Processing.

The Danish fishery for fish for processing is still growing in importance and amounts now by weight to more than $\frac{1}{4}$ of the total Danish yield. By far the largest quantities are caught in the Skagerak and the northern Kattegat; whiting and herring constitute about $\frac{3}{4}$ of the catches. The quantities of food fishes other than whiting, herring and sprat are insignificant (some 3—5 % of the total).

Rearing Experiments.

The experiments at Flødevigen on cod, plaice, herring and oyster were successful.

Crustacea.

The investigations concerning especially the deep sea prawn and Norwegian lobster were continued.

Erik M. Poulsen.

ENVIRONMENT

Hydrography.

1. Kattegat and Belts.

Table 1. Monthly Means of Salinity at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halskov Rev" (H) for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Surface

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A Mean	20.7	21.9	22.8		23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7	20.7	21.9	22.8
H Mean	16.2	16.3	15.6		16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6	16.2	16.3	15.6
A 1949	1.0	2.0	3.7	1950	0.8	—1.6	3.1	2.5	—1.3	1.4	1.1	—1.1	1.9	5.2	1.3	÷0.6
H 1949	2.8	1.4	6.0	1950	—1.4	3.3	3.4	0.5	—	—	—	—	—	—	—	(0.2)

Bottom

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A Mean[1])	32.2	32.4	32.1		31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8	32.2	32.4	32.1
H Mean	23.3	21.5	22.1		21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7	23.3	21.5	22.1
A 1949[2])	0.6	—0.2	1.1	1950	0.8	(1.5)	1.0	0.3	0.5	0.3	—0.4	1.1	1.3	0.3	1.4	1.7
H 1949	2.1	1.0	1.6	1950	—4.4	4.9	—0.5	3.1	—	—	—	—	—	—	—	(0.4)

Table 2. Monthly Means of Temperature at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halskov Rev" (H) for a Series of Years, and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Department.)

Surface

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A Mean	10.9	7.1	4.1		2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5	10.9	7.1	4.1
H Mean	11.1	7.3	4.0		2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5	11.1	7.3	4.0
A 1949	2.4	2.1	2.6	1950	(1.5)	—	1.0	1.9	2.1	0.5	0.1	(1.6)	1.2	1.3	0.5	0.2
H 1949	2.2	1.2	1.9	1950	0.1	—0.5	0.4	1.2	—	—	—	—	—	—	—	(—0.9)

Bottom

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A Mean[1])	12.1	10.2	8.1		6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1	12.1	10.2	8.1
H Mean	11.6	8.4	5.9		3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2	11.6	8.4	5.9
A 1949[2])	1.1	2.1	1.3	1950	(0.9)	—	0.2	0.3	0.6	0.7	0.0	(0.3)	2.2	2.3	0.8	—0.2
H 1949	1.5	1.3	0.7	1950	—0.9	0.3	0.0	1.1	—	—	—	—	—	—	—	(—0.5)

Table 3. Monthly Means of Residual Surface Currents in cm./sec. at the Lightvessel "Halskov Rev". The Current from the Baltic is stated as positive, towards the Baltic as negative.

(From the Danish Meteorological Institute, Nautical Department.)

1949	X	XI	XII	1950	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
																(9.-31.)
	—18.6	11.0	—10.1		33.3	24.3	16.3	11.5	—	—	—	—	—	—	—	53.5

NB. The Lightvessel "Halskov Rev" was out of commission from 10. May to 8. December 1950.
[1]) 28 m.
[2]) 30 m.

The surface salinity was unusually high in October 1949 in the entire Transition Area. The highest deviation from normal occurred at Kattegat SW. Lightvessel and amounted to 6.2 ‰ above normal, while the lowest occurred at Skagens Rev and amounted to 2.5 ‰ above normal. At Gedser Rev the salinity was 5.5 ‰ above normal. In the Belts and the western Baltic the high salinities occurred as early as September.

During the last three months of 1949 the surface temperatures in the Transition Area were unusually high, 1.5° to 2.5° above normal.

In 1950, January, February, June, July, November and December showed nearly normal surface temperatures. Warm periods occurred in March—April—May with mean temperatures in the Kattegat ranging from 1.0° to 2.2° above normal and in August—September—October with temperatures from 0.8° to 1.8° above normal.

HELGE THOMSEN.

2. Norway. Coast of Skagerak.

The sea temperatures near Arendal at a depth of one metre were fairly high all through the year, except in December (see Table 4).

Table 4. Sea Temperatures, 1 metre depth, off Arendal.

Average	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—45	3.04	1.96	2.24	4.53	9.0	12.91	16.19	16.52	14.45	11.22	7.69	5.09
1946	3.4	2.8	1.4	5.0	10.8	12.9	16.8	16.6	15.3	11.3	7.8	5.2
1947	1.3	—0.2	—0.1	3.7	11.3	14.2	17.0	19.7	16.7	12.9	8.3	5.9
1948	2.6	1.6	2.8	6.3	10.5	13.4	16.6	17.3	14.7	11.3	7.9	6.7
1949	5.4	4.5	3.2	5.1	9.7	13.1	17.6	15.8	16.4	12.6	9.0	7.2
1950	3.6	2.2	3.2	5.8	10.8	13.0	16.1	17.5	15.1	12.2	7.6	4.6

ALF DANNEVIG.

Benthic Food.

1. The Limfjord.

As usual, valuations with the Petersen grab (0.1 m.²) were carried out in the various parts of the Limfjord on two occasions during the year (in May and September). The figures below give the weight in g./m.² of bottom invertebrates obtained during the valuations in September 1949 (A) and May 1950 (S) in Livø Broad and Nissum Broad. (For explanation of the terms 1st-class food etc. *vide* Ann. Biol. III, p. 86).

	Livø Broad			Nissum Broad		
	1st class	2nd class	non food	1st class	2nd class	non food
A. 1949	12	11	560	13	45	669
S. 1950	5.7	11	366	5.8	41	66
Mean	8.8	11	463	9.4	43	368
Mean 1926—46	20	22	260	9.4	119	79

In Livø Broad the amount of 1st-class food was considerably below the average for the period 1926—46; compared with the preceding period (mean of autumn 1948 and spring 1949) it amounted to only half the quantity (19 g.) found then. The quantity of 2nd-class food amounted to half of the mean for 1926—46, but was far above the quantity found in the period A. 1948 and S. 1949. The group non-food was considerably above the mean for 1926—46 but below that for the period A. 1948 and S. 1949. In Nissum Broad the amount of 1st-class food was exactly the same as the average for 1926—46, while there was only about $^1/_3$ of the normal amount of 2nd-class food. As has now been the case for several years, the group non-food was considerably above the normal.

2. Other Danish Waters.

A number of bottom samples with the 0.1 m.² Petersen grab were taken in various parts of the Danish waters. The amount of 1st-class food in g/m.² was as follows: —

	C. Kattegat	N. Belts	Isefjord	Sound	S. Belts	W. Baltic
No. of Samples	10	22	20	15	25	10
1st-class food, g./m.²	22	25	4.2	12	14	16

Thus the quantity of 1st-class food was, on the whole, above the amount found in the two broads of the Limfjord. In the C. Kattegat only 22 g./m.² was found in 1950 against no less than 149 g./m.² in 1949. This was due mainly to a dense stock of *Mactra subtruncata* which almost disappeared during the period between the two investigations—having probably been devoured by the dense stock of young plaice present during the latter part of 1949.

J. KNUDSEN.

THE FISH

Eggs and Larvae.

Gadidae. Numerous hauls with the 2 m. ring-trawl were carried out from the S/S "Biologen" in various parts of the Danish waters from the end of February until the middle of May. The average number of cod larvae obtained per 1 hour are given below. The numbers in brackets represent the number of hauls. Means for 1923—39 are given for comparison.

	S. Kattegat	Sound	Belts	W. Baltic
April 1950....	62 (6)	13 (6)	328 (25)	892 (4)
— 1923—39	54	64	45	52
May 1950.....	551 (2)	—	256 (4)	—
— 1923—39.	26	—	32	—

It will be seen that considerable quantities of cod larvae were present—especially in the Western Baltic and the Belts. In these areas the number greatly exceeded the average number during 1923—39. Extremely large quantities were also found in the southern Kattegat in May. This abundance of larvae is well in accord with the rather large quantities of 0-group individuals found later in the year in the eel-tog survey. In late February and in March a number of hauls were made but only rather few cod larvae were found. The numbers of larvae of other gadoid fishes such as whiting, haddock etc. were quite insignificant.

Flat Fish. The numbers of flat fish larvae caught in the 2 m. ring-trawl per 1 hour were as follows. (In brackets average 1935—39).

April	No. of Stations	Plaice	Flounder	Dab
Belts.....	27	0 (0.6)	2.8 (1.4)	0 (4.8)
S. Kattegat.	6	0 (0.4)	45 (1.2)	0.5 (3.8)
C. Kattegat.	0	— (0)	— (0)	— (1.4)
Sound.....	6	0 (0.2)	2.5 (1.2)	0 (2.4)
May				
Belts.....	5	7.2 (0.2)	6.0 (1.0)	0 (4.4)
S. Kattegat.	1	0 (2.4)	0 (1.8)	0 (20)
C. Kattegat.	2	1.5 (0)	45 (0)	0 (0)
Sound.....	0	— (0.2)	— (2.2)	— (1.6)

It will be seen that the number of plaice larvae was above normal in May, while in April no larvae were found. A rich stock of flounder larvae was present, being above normal in all districts. The number of dab larvae was very small, and these few were found only in the southern Kattegat. It should be added that numerous hauls were also carried out in February and March, but no larvae of flat fish were caught.

J. B. KIRKEGAARD.

Gadidae.

1. Danish Waters.

Cod.

Fishing experiments were carried out in Danish waters from February to December 1950 with the eel-tog (a small-meshed seine). The numbers of cod of the various year-classes caught per 1 hour in the different areas are given in Table 5.

The 0-group (1950 year-class) was, in the Skagerak, the northern and central Kattegat, the Belts and the western Baltic, considerably more numerous than usual, and in the southern Kattegat and the Sound just a little less abundant than usual. The numbers of I-group (1949 year-class) were in the S. Kattegat above the normal, in the Belts normal, in the other waters below normal, but everywhere greater than in the previous year. All of the older year-classes were, just as in 1949, considerably below the normal strength.

In the Belt Sea comparative hauls were made in areas where fishing with seines and trawls is prohibited and in neighbouring areas where such fishing is allowed. In the closed areas the stock of cod was several times as large as in the open areas; this shows not only that such a protection is of considerable value to the stock, but also that the cod stock (I-III-groups) is rather local.

Racial Investigations. As in previous years, analyses of number of vertebrae and of second dorsal fin rays were carried out.

	Year-Class	Vert. Ind. S.
S. Kattegat	1949	51.98 (203)
Limfjord	1950	51.73 (41)
Belt Sea	1950	52.05 (566)
	1949	51.94 (22)

	Year-Class	Rays, Ind. D_2
S. Kattegat	1949	18.66 (180)
Sound	1949	18.85 (68)
Sound	1948	18.72 (79)
	1947	17.84 (51)
Belt Sea	1950	18.37 (591)
	1949	18.70 (528)
	1948	18.84 (183)
	1947	18.22 (45)

Table 5. Number of Cod caught per 1 hour in the Eel-Tog.

The figures in brackets state for the corresponding age-groups, the means for the 10-year period 1930—39. For the 0-group (year-class 1950) only catches made after 1. June are considered.

	No. of Stations		All	Year-class									
	Febr.-Dec.	June-Dec.	year-classes	1950	1949	1948	1947	1946	1945	older
Skagerak ..	9	9	19 (2.1)	18 (0.6)	0.6 (1.1)	0.2 (0.4)	0 (0.1)	0 (0.05)	0 (0.02)	0 (0.02)
N. Kattegat.	16	16	7.4 (11)	6.0 (1.8)	1.2 (4.6)	0.2 (2.8)	0 (1.2)	0 (0.1)	0 (0.02)	0 (0
C. Kattegat.	14	9	70 (45)	68 (47)	1.2 (4.0)	0.8 (2.0)	0.2 (0.8)	0.2 (0.2)	0 (0.04)	0 (0.02)
S. Kattegat.	15	5	32 (31)	6.4 (16)	24 (15)	0.4 (3.2)	0.4 (2.4)	0.4 (0.4)	0 (0.4)	0.2 (0.04)
Sound.....	7	2	20 (69)	8.0 (13)	6.8 (24)	2.6 (24)	2.2 (9.0)	0.2 (2.0)	0.2 (2.2)	0 (0.3)
Belts.....	98	74	74 (38)	58 (32)	13 (12)	0.8 (4.6)	2.8 (3.0)	0.02(0.8)	0.05(0.2)	0.02(0.1)
W. Baltic ..	9	8	19 (25)	11 (2.4)	5.6 (16)	1.2 (4.0)	0.8 (2.6)	0 (0.4)	0 (0.6)	0 (0.02)

Thus the 1947 year-class has a very low number of D_2 rays, whereas the 1949 and 1948 year-classes have a number somewhat above normal; the 1950 year-class scarcely differs from the normal.

Erik M. Poulsen.

Whiting.

The following figures give the numbers of whiting caught in 1950 per 1 hour fishing with the eel-tog. For the sake of comparison the results from 1949 and the average value for the period 1927—39 are also given. The numbers in brackets indicate the number of hauls.

	1950	1949	1927—39
Skagerak.....	167 (9)	55 (12)	7
Kattegat, Sound	146 (50)	40 (42)	42
Belt Sea.....	32 (91)	4 (50)	12

It will be seen that, in 1950, unusually large quantities of whiting were present. As a matter of fact the stock was the largest found during the period 1927—50. As in previous years the stock consisted mainly of quite young individuals (0- and I-group forming about 90 % of the population). It thus seems as if the heavy fishing on young whiting, which has been carried out now for many years in the Danish waters, does not cause any appreciable depletion in recruitment to the stock in these waters.

Jørgen Knudsen.

2. Norwegian Waters.

Young Fish.

The 0-group cod in the littoral region was more plentiful in 1950 than at any other time since 1945. This was especially the case in the areas where cod larvae from Flødevigen had been liberated. The abundance of 0-group whiting was extremely low in the Oslofjord. The average numbers per haul taken by the usual experimental fishing in the littoral region in September and October are recorded in Table 6.

The experimental fishing with traps at Flødevigen resulted in catches of 101 cod per trap. The 1948 year-class was relatively plentiful.

Alf Dannevig.

Table 6. Experimental Fishing, Average Number per Haul.

	Cod		Whiting	Pollack
	0-Gr.	I-Gr.[1])	0-Gr.	0-Gr.
Skagerak Coast.				
77 hauls.				
Average 25 years ...	13.7	1.7	17.8	16.6
1945.....	13.0	1.0	65.9	32.8
1946.....	1.8	1.1	20.9	3.6
1947.....	2.5	0.4	22.6	2.2
1948.....	4.3	1.7	19.0	1.4
1949.....	1.5	0.7	16.6	3.5
1950	4.2	0.9	19.1	3.0
Oslofjord.				
56 hauls.				
Average 6 years				
1936/39, 1945/46 ...	37.9	3.5	13.3	5.4
1945.....	92.0	1.2	34.5	16.0
1946.....	0.9	9.1	15.3	0.6
1947.....	2.4	0.5	16.1	0.9
1948.....	7.1	0.4	17.1	1.5
1949.....	1.9	1.8	40.6	1.9
1950.....	7.7	1.7	9.5	1.8

[1]) A few older fish included.

Plaice, Flounder, and Turbot.

1. Coastal Investigations. 0- and I-Groups (Fig. 1).

(a) **Danish Coasts.** The numbers of 0-group plaice and flounder caught with a Johansen young-plaice-trawl in 1—2 m. depth 7. July—26. Sept. 1950 are given in Table 7. The trawl used in these investigations was, on account of a constructional fault which could not be corrected, of slightly greater dimensions than the standard trawl; the figures for the catches of 0-group plaice have therefore been

Figure 1. Number of Plaice of the 0-Group (year-class 1950) taken per 30 min. haul with the Johansen young-plaice trawl, except at Bornholm, where the hand-push net also was used.

Table 7. Number of Plaice and Flounder caught per 1 hour on the Danish Coasts.

In brackets mean for 1927—49.

	No. of Stations	Plaice 0-Group	Flounder 0-Group
Skagerak	5	14 (46)	0 (0)
N. Kattegat	23	131 (68)	0 (0.6)
C. Kattegat	31	7 (27)	1 (1)
S. Kattegat	14	10 (26)	0 (0.4)
Sound	14	14 (20)	2 (20)
Belts	95	25 (25)	0.4 (8)
W. Baltic	13	11 (12)	1.3 (4)

corrected according to the relative ground-rope lengths of the trawl used and the standard trawl. The catching power on I-group plaice of the trawl used was considerably greater than that of the standard trawl, but the correction factor is not known, hence no values for the frequency of the I-group comparable to those of the previous years could be given for 1950.

The number of 0-group plaice was below normal in the Skagerak, about twice normal in the northern Kattegat, about one-third of the normal in the central and southern Kattegat, normal in the Belt Sea and the western Baltic, and a little below normal in the Sound. The surface temperature in January-February was a little below normal and the strength of the year-class in the southern Kattegat and the Belt Sea is as might be expected with such temperatures.

In 1950 only a few 0-group plaice were found in the deeper water in the Kattegat as was also the case in 1949 (cp. Ann. Biol. VI, p. 148) but they were found in fairly large quantities between 10 and 20 m. depth in the southern part of the Belts.

The numbers of 0-group flounder were very much below normal in the Sound, the Belts and the western Baltic.

Aage J. C. Jensen.

(b) **Swedish Coasts.** Coastal investigations of young flat fish were carried out as in previous years. Owing to various circumstances these investigations were limited to the west coast. They were carried out in the Skagerak during August (9.—12. VIII.) and in the Kattegat during October (23.—25. X.), usually in $\frac{1}{2}$—$1\frac{1}{2}$ m. depth (Table 8).

Table 8. Number of 0- and I-Group Plaice caught per 1 hour on the Swedish Coasts.

	1949		Means 1929-38		1950		No. of
	0-Gr.	I-Gr.	0-Gr.	I-Gr.	0-Gr.	I-Gr.	Stats.
Skagerak	54	2	100	2	102	1	24
N. Kattegat	123	4	150	4	12	2	4
S. Kattegat	176	0	192	4	67	4	18
Sound	212	0	14	0	—	—	0

The 0-group plaice was, in the Skagerak, relatively well represented compared with the means for the years 1929—1938. Both in the northern and southern Kattegat the number of 0-group plaice was very small and considerably below both the number in 1949 and the mean.

The 0-group turbot was practically absent at the stations.

Arvid R. Molander.

2. The Stock of Plaice in the open Sea.

The number of plaice of the various age-groups found in the catches taken by S/S "Biologen" are shown in Table 9.

Table 9. Number of the various Age-Groups of Plaice caught per 1 hour with the Eel-Tog in 1950.

In brackets averages for 1927—39.

	No. of St.	0	I	II	III	IV+
N. Kattegat						
5—14 m.	1	0 (9)	118 (161)	14 (153)	6 (44)	0 (1.4)
15—24 m.	5	0 (0.2)	42 (76)	12 (117)	10 (49)	0 (0.5)
25—34 m.	3	0 (0)	2 (3)	1.3 (29)	0.6 (9)	0 (0.5)
> 35 m.	5	0 (0)	0 (0.2)	0.2 (1.5)	0.2 (1.5)	0 (0.4)
C. and S. Kattegat						
5—14 m.	12	0 (3)	6 (20)	10 (15)	0.2 (1.0)	0 (0.1)
15—34 m.	17	0 (0)	0.1 (0.7)	0.2 (0.3)	0.5 (0.2)	0.1 (0.04)
Belts						
5—14 m.	28	0.9 (3)	18 (7)	0.6 (5)	0.1 (2)	0 (0.2)
15—34 m.	69	0.9 (0.4)	3 (1.6)	0.7 (1.5)	0.1 (0.6)	0 (0.3)

The number of the 0-group is calculated from investigations after 1. July.

In the northern Kattegat the density of the stock of 1- and 2-year-old plaice was far below the average as was the case also in 1949. In the central Kattegat the number was about normal, but in the southern Kattegat it was very small. In the Belts the I-group was found in greater numbers than usual; the older age-groups were sparsely represented. The stock of the I-group in the western Baltic and the Sound was also sparse.

AAGE J. C. JENSEN.

3. The Limfjord Stock of Plaice.

Investigations were carried out by means of the eel-tog in summer (end of May) and in autumn (September). The number caught per 1 hour in the various parts of the fjord are shown below. Numbers in brackets give the average for the years 1927—39:—

	Nissum Br.	Venø-Kås Br.	Sallingsund
Summer...	200 (712)	22 (168)	0 (92)
Autumn...	126 (962)	8 (184)	34 (24)

	Livø Br.	Thisted-Visby Br.	E. of Salling
Summer...	4 (12)	3 (24)	0 (10)
Autumn...	1 (4)	1 (7)	0.6 (2)

The stock was thus much below normal, especially in the western part, where it was the lowest observed in the period 1927—50.

The age composition of the stock in the Nissum Br. was as follows (catch per 1 hour). The bracketed figures are the means for 1927—39: —

Age-Group	Year-Class	May	September
0	1950	—	50 (80)
I	1949	44 (152)	48 (448)
II	1948	104 (308)	22 (298)
III	1947	50 (206)	3 (124)
IV+	1946	2 (54)	0 (34)

Only the 0-group was fairly well represented, all the other age-groups, especially the older ones (IV+groups), being of far below normal strength.

In accordance with the sparseness of the stock the growth had been fast compared with that of the dense stock some years back. This is illustrated by the following figures of mean length in cm. of each age-group in September 1950 and September 1946.

	Age-Group				Total No. caught
Year	0	I	II	III	per 1 hour
1946	7.1	11.7	16.0	19.5	1980
1950	8.3	15.6	21.0	23.5	126

Thus the I- and II-groups, in 1950 had about the same length as the II- and III-groups of 1946.

ERIK M. POULSEN.

4. Market Measurements of Plaice.

In the northern and central Kattegat the mean length in 1950 was 1—2 cm. greater than in 1949. In 1948 the mean length had decreased on account of the rich 1945 year-class joining the stock of commercial plaice. In 1950 the next rich year-class, from 1948, had not yet joined the stock which therefore contained relatively many old and large fish. In the southernmost parts of the Kattegat near its limit with the Belts a small decrease was found; this was undoubtedly caused by a recruitment from the 1949 year-class in this part of the area, where the growth is faster than in the northern parts. (See Table 10).

Table 10. Length Composition of Plaice (%) in the Kattegat.

	Depth	Length, cm.						
	m.	26-30	31-35	36-40	41-45	46-50	51-55	Mean
E. of the Scaw								
1948, Nov.....	5	79	20	1	—	—	—	29.4
1949, Nov. Dec.	8	66	28	4	—	1	1	30.6
1950, Nov.....	9	45	39	17	—	—	—	32.2
1949, Nov.....	20	62	34	4	—	—	—	30.1
1950, Nov.....	17	27	64	9	—	—	—	32.8
N. of Læsø								
1949, Apr. May.	9	77	23	—	—	—	—	29.4
1950, April	9	61	37	2	—	—	—	30.3
W. af Læsø								
1949, Apr. May.	9	77	23	—	—	—	—	29.4
1950, April	9	63	34	3	—	—	—	30.3
ca. 25 miles N. of Fornæs								
1949, Oct.	12	80	13	5	1	—	—	29.5
1950, Nov.....	12	74	19	6	2	—	—	30.2
ca. 10 miles N. E. of Fornæs								
1949, Oct. Nov..	16	71	18	10	1	—	—	30.3
1950, Sept.-Nov.	18	43	34	17	6	—	—	32.9
S. Kattegat, Briseis Flak								
1949, July	15	39	43	11	8	—	—	32.5
1950, Aug.....	15	44	42	14	—	—	—	31.9
S. Kattegat, Havknude Flak								
1949, July	21	33	38	26	2	—	—	33.1
1950, July	20	52	28	13	7	—	—	32.0

AAGE J. C. JENSEN.

5. Transplantations of Plaice.

The transplantations of young plaice to the inner Danish waters were continued. From the end of March to the beginning af May 273,700 kg. or about 3.3 millions of young plaice were caught in the Nissum Broad (western Limfjord) for transplantation. Samples were examined as to age, length and number of anal fin rays: —

Age-Group	Year-Class	Number analysed	%	Mean Length, cm.	No. of Anal Fin Rays
II	1948	516	27	15.7 + 0.5	54.37
III	1947	1300	69	19.8 + 0.5	53.54
IV	1946	84	4	23.2 + 0.5	53.81
V	1945	5	—	—	—

The mean length was, as in the previous year, 2—2½ cm. above the normal, this being in accordance with the sparseness of the stock in the Nissum Broad in the years 1949—50.

The number of anal fin rays of the 1947 year-class was low as the countings in 1949 had already shown. The 1948 year-class has a number of fin rays well above the normal.

(a) The transplantations to the Belt Sea and adjacent waters comprised the following quantities:—

	Tons	Thousand Fish
S. of Læsø	8.0	101
S. Kattegat + Isefjord	8.1	98
The Sound	4.0	40
N. Belt Sea	42.3	518
S. Belt Sea	50.5	580
W. Baltic	16.0	182
Total	128.9	1519

The quantity transplanted was about twice as great as in 1949.

Samples of the transplanted plaice were marked and up to the beginning of February 7.3 % had been recaptured. The percentage of recaptures varied in the various places from 2 to 25 %, the best results being obtained N. of Funen and in the Sound.

During the winter 1950/51 samples of plaice caught by fishermen in the Belt Sea and adjacent waters were analysed and showed that 7 % by weight of the commercial catches consisted of transplanted plaice.

(b) To the inner broads of the Limfjord were transplanted 144.8 tons or 1,789,000 individuals. From the samples marked, 30 % were recaptured up to the beginning of February.

Erik M. Poulsen.

6. Flounder and Turbot in the Limfjord.

The stock of flounder was, as in previous years, somewhat below the normal. Of 200 turbot marked in the central part of the fjord (see Ann. Biol. 1949, p. 151—52) 39 individuals or 20 % were recaptured up to December 1950. They were all recaptured in the central part of the fjord, which shows that the turbot of the Limfjord are native, as is the case with the flounder, and do not migrate in and out of the fjord as do the plaice and the dab. The growth of the marked turbot was only small, 2½—3 cm. in the course of a year.

Erik M. Poulsen.

Dab.

1. Limfjord Stock.

The stock of dab in 1950 was the smallest observed in the period 1927—50. The following numbers were caught per 1 hour with the eel-tog. (They are the means of May and September. The numbers in brackets are means for 1927—46): —

Nissum Br.	Venø-Kås	Salling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
32 (158)	6 (40)	3 (26)	1.2 (3)	0.6 (1.4)	0 (0.8)

The growth was, in accordance with the thin stock, rather strong—just as it was in the case of the plaice. The following figures give the mean size in cm. of the I- and the II-group in 1950 (15.—17. Sept.) compared with 1946 (18. Sept.) and 1943 (16. Sept.) when the stock of dab was fairly large (number caught per 1 hour in brackets): —

Age-Group	1950 (32)	1946 (100)	1943 (178)
I	11.3	9.8	9.4
II	17.8	17.4	16.3

A number of I- and II-group dabs from the western part of the Limfjord were analysed for number of anal fin rays and vertebrae: —

Age-Group	Year-Class	Anal Fin Rays	Vert. S.
I	1949	56.80 (40 ind.)	40.37 (49 ind.)
II	1950	56.82 (187 ind.)	40.16 (185 ind.)

Erik M. Poulsen.

2. Other Danish Waters.

The number of dabs caught per 1 hour fishing with the eel-tog from S/S "Biologen"

in various parts of the Danish waters in 1950 is shown in the following table:—

	No. of hauls	No./Hour	Average No. 1 hour 1930—39
Skagerak	9	100	89
N. Kattegat	17	194	310
C. Kattegat	16	22	69
S. Kattegat	15	104	121
Belts	99	60	176
W. Baltic	7	11	93

It appears that the stock of dab was considerably below the average for the period 1930—39, except in the Skagerak where it was slightly above the average. The decrease is particularly evident in the Belts and W. Baltic. It should be added that in 1949 also the stock was below the average for 1930—39.

Age determination was carried out in nearly all the specimens obtained and the results have been drawn up in the following table:

	Total No. of specimens examined	I-Gr. (1949)	II-Gr. (1948)	III-Gr. (1947 and earlier)
		%	%	%
Skagerak	447	84.8	13.4	1.8
N. Kattegat	1660	84.7	13.7	1.5
C. Kattegat	170	77.5	20.0	2.9
S. Kattegat	719	34.9	45.8	19.3
Belts	2677	69.3	27.3	3.3
W. Baltic	38	15.8	73.7	10.5
Total ..	5711	70.6	24.7	4.7

It should be added that a few 0-group individuals were caught during the later part of the summer. As in the previous year, the I- and II-groups form the great majority of the stock (95.3 % in 1950 and 94 % in 1949). In the southern Kattegat and to some extent also in the Belts the percentage of I-group (34.9 and 69.3 %) was lower in 1950 than in 1949 (70.3 and 78.2 %).

Counts of vertebrae and anal fin rays were carried out on specimens of the II-group. The results were as follows; the numbers in brackets give the number of specimens counted:—

	No. anal fin rays	No. vertebrae
N. Kattegat	54.46 (76)	40.42 (36)
C. Kattegat	56.72 (25)	—
S. Kattegat	53.66 (174)	40.00 (76)
N. Belt Sea ...	53.62 (263)	39.90 (103)
S. Belt Sea	53.70 (145)	39.93 (68)
W. Baltic	53.37 (49)	39.65 (23)

If we compare the above results with those from 1949 there is seen to be a considerable decrease in the number of anal fin rays as between the 1947 year-class and the 1948 year-class; the difference amounts to 2.65 rays in the northern Kattegat and is also very considerable in the other areas. There do not seem to have been corresponding changes in the number of vertebrae; the values in the 1948 year-class are practically the same as those in the 1947 year-class. The above results seem to indicate considerable changes in the meristic characters of the dab from one year to another and also indicate that the subject is more complicated than appears from previous investigations in the Danish waters.

J. B. Kirkegaard and J. Knudsen.

Eel.

1. The Limfjord.

The number of eels caught per hour with the eel-tog in 1950 were as follows:—

	May			September		
	No. of Stations	1950	1930/39	No. of Stations	1950	1930/39
Nissum Br.	19	0.2	1.8	6	1.3	0.4
Venø Kås ..	5	0.4	1.4	5	0.0	3.0
Sallingsund	3	0.0	2.0	3	0.0	3.6
Livø Br....	9	0.2	2.2	8	0.2	5.0
Thisted Br.	13	0.8	2.6	8	0.5	8.0
E. of Salling	3	0.7	2.4	4	0.5	5.6

Only in the Nissum Broad, where the density is normally very low, was the mean number caught in September 1950 above the average for the pre-war years (shown in the last columns of the table). In other waters the density was far below the normal for the period 1930—39. In accordance with the low density of the stock, the yields of the fisheries for yellow eels and for silver eels were below the mean for the previous 20 years.

2. Isefjord–Roskildefjord.

In August 1949 and September 1950 the following numbers of eels were caught per 1 hour with the eel-seine (number of stations in brackets):—

	1949	1950
Isefjord, outer broad ...	8 (3)	0.6 (3)
— inner — ...	23 (5)	33 (5)
Roskildefjord	34 (5)	18 (10)

The great decrease in density of 1950 as compared to 1949 may partly be due to the fishing in 1950 being carried out about a

month later in the year than in 1949. The emigration of the silver eel begins about the 1. September. The figures cannot be compared with those found for the Limfjord since the eel-seine is a far better implement for catching eels than is the eel-tog.

3. Prediction.

From a study of the summer temperature of the water it was predicted that the yield of the silver eel fishery should be 15—20 % above the normal in the Baltic, the Belts and the Limfjord. In the Belts and the western Baltic the yield of the fishery was about 30 % above the mean of the previous 20 years. In the Limfjord it was about 5 % below this mean, probably on account of the very intensive trawl fishery.

Aage J. C. Jensen.

Fish for Processing.

The Danish fishery for fish-meal factories and fish-pond food has been continued and showed, for the year 1950, a considerable increase:

Year:	1947	1948	1949	1950
Mill. kg:	23.8	41.7	39.7	64.9

The catch in the various Danish waters was dispersed in the following way:—

North Sea	6,811 tons
Skagerak (Skagen excl.)	3,433 —
Skagen (both Skagerak and Kattegat)	32,673 — [1]
Kattegat (Skagen excl.)	17,403 —
Belt Sea	2,856 —
Limfjord	1,680 —
Total	64,856 tons

[1]) Catch from Swedish fishery vessels included.

The greater part was caught in the Skagerak and northern Kattegat and the main landing-places were the harbours of Skagen, Hirtshals and Frederikshavn. The catch from the North Sea was mainly of large herring normally caught for consumption but sold to the fish-meal factory in Esbjerg.

During the year 46 samples from the northern area (Skagerak and northern Kattegat) and 63 samples from the southern area (the Belt Sea) were investigated partly at the harbours and partly at the laboratory of the Danish Biological Station. The species found in the samples and their percentage abundance by weight calculated are given in Table 11 below.

From the northern part of the Great Belt a further 12 samples of fish caught in 18 mm. meshes and sold for processing were investigated. They consisted almost entirely of whiting.

The fishery with the wastefish-trawl is the real wastefish fishery while wastefish taken by the other gears are only by-products especially of the sprat and herring fishery.

In contrast to the northern area, in the Belt Sea there is no great difference between the composition of the catches in small-meshed and large-meshed trawls.

I. Bohus Jensen.

Rearing Experiments.

The rearing experiments of plaice larvae at Flødevigen were very successful again this year. The mortality up to the stage of metamorphosis was hardly more than a few percent.

Experiments on cod and herring larvae were also very successful.

Table 11. Wastefish Fishery.

	Northern Area.			Southern Area.	
Gear	Wastefish-trawl	Herring-tr.	Prawn-tr.	Sprat-tr.	Herring-tr.
Mesh (knot to knot)	11-12 mm.	16 mm.	16 mm.	11—15 mm.	16 mm.
No. of samples	35	7	4	20	43
Whiting	30.6 %	60.3 %	23.3 %	17.6 %	21.2 %
Herring	46.4 -	19.4 -	0.7 -	49.2 -	43.7 -
Sprat	15.3 -	0.7 -	0.0 -	30.3 -	34.5 -
Other food-fishes[1])	3.2 -	4.9 -	4.6 -	0.1 -	0.4 -
Other fishes	3.2 -[2])	14.3 -[2])	72.4 -[3])	2.9 -[2])	0.3 -[3])
Invertebrates	0.7 -	0.8 -	0.8 -	0.01-	0.1 -

[1]) Haddock, hake, cod, dab, and mackerel.

[2]) Poor cod, Norway pout, long rough dab, horse mackerel, rockling, gurnard, and anchovy.

[3]) Poor cod, Norway pout, long rough dab, gurnard, great silver smelt (22.3 %), Couch's whiting (19.9 %), rockling, Norway haddock, witch, silvery pout, dragonet, dogfish, and blue ling.

Approximately 7000 lobster larvae were reared to the bottom stage and liberated.

From the hatchery 250 millions of cod fry were liberated in the fjords.

ALF DANNEVIG.

Shellfish.

Oyster.

The oyster thrived in the natural ponds. Some spawning took place, and a spatfall resulted.

Lobster.

The statistics covering 25 fishermen proved that the fishing along the Skagerak coast was not quite so good as in 1949, giving an average of 5.8 lobsters per trap.

ALF DANNEVIG.

Deep Sea Prawn.

In July experimental fishing was carried out, as in 1948—49, with the commercial trawl in the Skagerak. Two mesh-sizes of the bag (18 mm. and 22 mm. from knot to knot) and Norwegian as well as Danish closing methods were used. The following mean sizes (cm.) of the prawns (measured from the eye to the point of the telson) were found:—

Closing Method	18-mm. meshes	22-mm. meshes
Norwegian.....	7.9	8.2
Danish.....	7.6	8.4

The results confirm those of the previous years, viz., that the Norwegian closing method does not yield bigger prawns than the Danish one, and that the 22-mm. bag, as would be expected, gives a catch of prawns bigger than those caught in the 18-mm. bag. There is hardly any doubt that by using bigger meshes in the bag than have hitherto been used by the commercial fishery (16—18 mm.) a valuable protection of the smaller prawns could be achieved.

Norwegian Lobster.

During the fishery with the eel-tog in the northern Kattegat and the eastern Skagerak a number of Norwegian lobsters were caught. The mean length of the males (237 spec.) was 14.1 cm., the same as in 1949, and 1.1 cm. below the mean length for 1948 and for the years 1935/39.

ERIK M. POULSEN.

Baltic Area.

INTRODUCTION

Contributions to this report have been received from Mr. HELGE THOMSEN, Copenhagen, Dr. AAGE J. C. JENSEN, Copenhagen and Dr. HARALD ALANDER, Gothenburg.

Environment.

THOMSEN has compiled a table of the monthly means of the surface temperature and salinity at Christiansø in the Bornholm area and has made an isoplete diagram showing the variations of the oxygen contents at different depths in the Bornholm Deep. The diagram is based on observations made twice a month by the Danish Meteorological Institute in collaboration with the Danish Hydrographical Laboratory. The diagram indicates very clearly the intermittent renewal of the bottom water in this area (at the end of January 1949 and in March 1950). We hope that these regular observations, which are very useful alongside the biological observations in this area, will be continued.

JENSEN and ALANDER give the result of some hydrographical observations in the Bornholm area which complete THOMSEN's diagram.

According to ALANDER, the comparatively high salinity of the bottom layers in the central Baltic which was observed in 1949 had, by January 1950, somewhat decreased. In that area there also seemed to have been a stronger intermixing than usual between the upper and lower water layers. Some hydrographic investigations in connection with observations on the commercial herring fishery in the central Baltic in January were of special interest as they indicated that the best catches were made in the district where the temperature of the upper water layers was highest.

A slight decrease of the salinity was also observed in the northern Baltic (the Sea of Åland and Gulf of Bothnia).

JENSEN gives a survey of his observations on the fat content of the plankton in the Bornholm area in 1950.

Fish Species.

Surveys are given by JENSEN of Danish fishing experiments with ring-trawl, eel-tog, young fish trawl and hand push-net for investigating the stock of fish larvae and young fish. The catches were generally small, only the numbers of 0-group plaice and turbot at Bornholm being somewhat above normal.

ALANDER is of the opinion that the stock of cod in the Baltic is still strong, and he also got good catches of cod on a soft bottom in the central Baltic where previously cod seemed to be scarce.

The trawl-fishery for cod which is carried out in rather deep water in the southern Baltic has, according to ALANDER, fluctuated a great deal, and he points out that these fluctuations may to a certain extent be due to the variations in the oxygen content of the bottom layer. This problem ought to be more closely studied.

Coordinated fishing experiments with the Danish and Swedish research vessels "Biologen" and "Eystrasalt" in the spring 1949 indicated that, in the Bornholm area at that time, the male cod predominated in the catches in the deeper parts while the females were more numerous in shallow water nearer the Swedish coast. According to ALANDER, this may indicate that the two sexes do not arrive at the spawning places in the deeper part of the Bornholm Basin at the same time.

ALANDER has found that both turbot and sprat are now fairly numerous in the Sea of Bothnia, and he ascribes this to the comparatively high salinity in the area during recent years. Using a pelagic trawl and echo-sounder he has studied closely the behaviour of the sprat shoals in the Sea of Bothnia and has found that, irrespective of the hydrographical conditions, the shoals occur in June and July at a depth of 12—15 m. below the surface.

CHR. HESSLE.

ENVIRONMENT

Hydrography.

Danish Observations.

Table 1. Monthly Means of Surface Temperature and Salinity at Christianso, N. of Bornholm.

(From the Danish Meteorological Institute, Nautical Department).

	1949			1950											
	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temp.....	13.3	9.8	7.0	4.0	2.4	2.4	3.9	7.5	12.8	16.0	17.4	15.6	12.1	7.7	5.6
Sal. ‰.....	7.9	8.0	8.1	8.0	7.8	8.0	7.9	7.9	7.7	7.7	7.5	7.6	7.8	7.9	7.7

The monthly mean temperatures were a little above normal throughout 1950, except in November, when the temperature was 0.4 °C. below normal. The highest deviation from normal temperature occurred in June and amounted to 1.8° C. above normal.

On 31. August, 1949, twice-monthly observations of temperature, salinity and oxygen content in the Bornholm Deep 1.5 nautical miles ESE. of Christiansø were initiated by the Danish Meteorological Institute in collaboration with the Danish Hydrographical Laboratory. The observations have been printed in full in the *Nautical-Meteorological Annual*. The variation of the oxygen content is displayed in the isoplete diagram, Figure 1. By the end of the summer 1949 the oxygen content of the layer below 70 m. had decreased to less than 1 ml./l. O_2, the minimum value being 0.24 ml./l. corresponding to a saturation percentage of 3.3. Renewals of the bottom layer took place by the end of December, bringing the oxygen content above 5 ml./l. and again in March, bringing the oxygen content above 7 ml./l., to at least 7.44 ml./l. corresponding to 87.5 % saturation. During the spring and summer months the oxygen content again decreased so that, by the end of December, it was only 0.45 ml./l. at the bottom (100 m.), corresponding to a saturation percentage of 5.8.

HELGE THOMSEN.

At Christiansø the cold water layer at 40—50 m. depth in August had a rather high temperature of about 4°, corresponding to the preceding mild winter (Table 2). Moreover, the hydrography was characterized by a very high temperature at 60—65 m. depth as was also found in 1939 and 1941. In the bottom layer both temperature and salinity were lower than in August 1949, and it is seen from the oxygen contents that this is due to a new inflow which took place after August 1949.

AAGE J. C. JENSEN.

Table 2. Hydrography at Christianso.

Depth	28.8. 1949			27.8. 1950		
m.	t°	S ‰	O_2 ccm.	t°	S ‰	O_2 ccm.
2....	16.8	8.1	—	17.4	—	—
30....	—	—	—	6.5	7.8	—
40....	—	—	—	4.3	8.2	—
50....	4.7	8.8	—	4.0	8.7	—
60....	6.4	11.3	4.15	9.2	13.5	—
65....	—	—	—	9.2	14.5	—
70....	6.3	14.7	2.12	7.6	15.5	—
80....	7.7	16.7	0.53	6.5	15.9	—
90....	7.7[1])	17.0[1])	0.26[1])	6.3	16.3	1.3
100....	—	—	—	6.0	16.7	1.2

[1]) at 85 m.

Swedish Observations.

Hydrographic investigations in 1950 were carried out in cooperation with Finnish hydrographers during cruises in the central Baltic with the "Skagerak" in January and in the

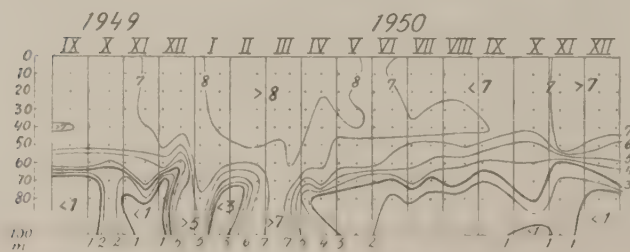


Figure 1. Oxygen Content of the Bornholm Deep, 1.5 miles ESE. of Christianso.

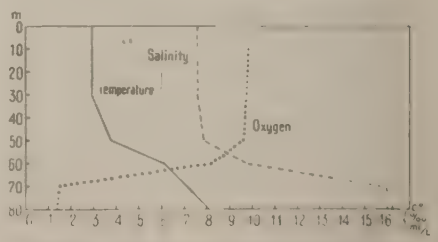


Figure 2. Temperature, Salinity and Oxygen Contents, north of Bornholm, 29.1.1950.

East of Gotland, 24.1.1950.

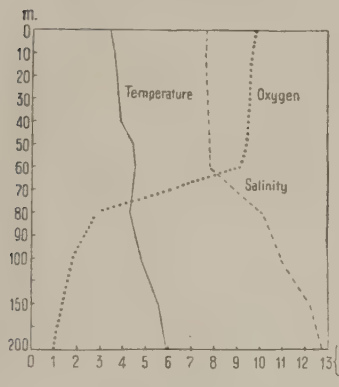


Figure 3.

Landsort Deep, 23.1.1950.

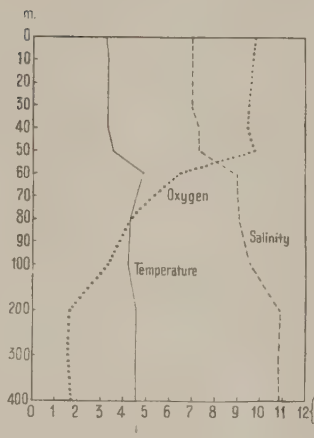


Figure 4.

West of Gotland, 25.1.1950.

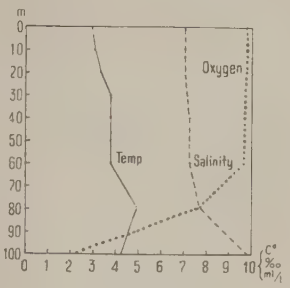


Figure 5.

Temperature, Salinity and Oxygen Contents.

Gulf of Bothnia with the "Eystrasalt" in August. In the southern Baltic only very few observations were made from the research vessels.

One of the southern Baltic observations carried out in January north of Bornholm, deserves special mention, as it shows some interesting features. The temperature of the bottom water was rather high, but the salinity was about normal. The oxygen content however was very low even at 70 m., which is not common in the southern Baltic, and may have had an influence upon the distribution of the fish in the Bornholm area (Fig. 2).

The hydrographic conditions in the central Baltic in January were also of some interest. East of Gotland the temperature and the salinity of the bottom water had decreased a little from the rather high values found in the summer 1949 (Fig. 3). In the Landsort Deep no changes seem to have taken place in the deepest part of the basin, but, between 80 and 200 m., fairly big changes were indicated by a decrease in salinity and a very pronounced increase in oxygen content (Fig. 4). West of Gotland, where the bottom water, as a rule, is stationary, an intermixing seems to have taken place. The border between the upper water layers with low salinity and the more saline bottom water was less distinct than in

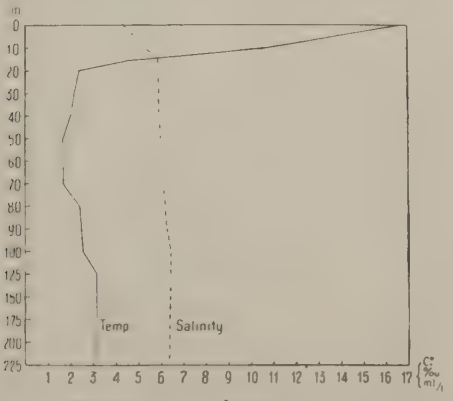


Figure 6. Sea of Åland, 29.8.1950.

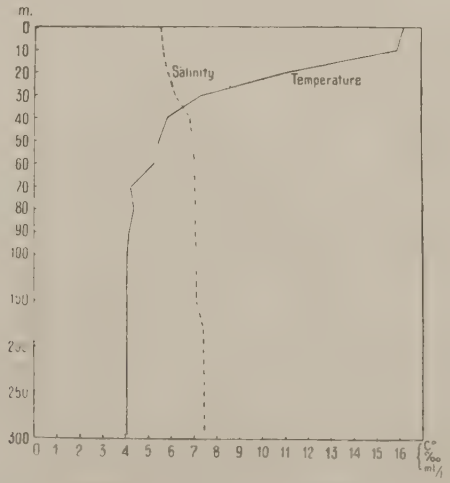


Figure 7. Ulvö Deep, 19.8.1950.

Temperature and Salinity.

the preceding years, and situated a good deal deeper. The oxygen content was somewhat higher than in the preceding summer (Fig. 5). On the whole, there seems to have been more intermixing than usual between the upper and the lower water layers in the central Baltic.

Special attention was paid to the winter differences between the water in the archipelago of the Swedish east coast and the water of the open sea. In the archipelago, the water from the surface down to 30 m. or more had a low temperature, 0°—1° C. Off the coast the temperature rose fairly rapidly to about 3° C., or more. South-east of Häradsskär lighthouse, the temperature of the upper water layers was remarkably high at 3° or 4° C., which may have been of importance for the distribution of the herring shoals. The herring fishery was then rather poor in the central Baltic but, in the vicinity of Häradsskär, fairly good catches were obtained.

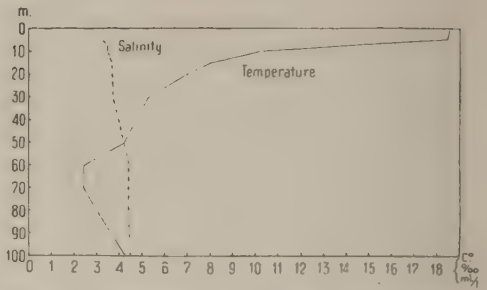


Figure 8. Temperature and Salinity, Bay of Bothnia, 10.8.1950.

In the Sea of Åland and in the Gulf of Bothnia the hydrographic conditions in August 1950 showed no remarkable difference from those (Fig. 6—8) of the preceding year, but there also a slight decrease of the salinity could be traced.

HARALD ALANDER.

Plankton.

The fat content of the plankton round Bornholm in August varied considerably from place to place ranging between 1.6 and 20.7%. The average of 19 samples was 11% which was lower than the mean for the previous nine years.

AAGE J. C. JENSEN.

THE FISH

Fish Larvae.

Fishing with the ring-trawl from S/S "Biologen" 22.—23. April, 1950 at 7 stations yielded, per hour, 1 pleuronectid larva, 6 cod larvae and 0.5 herring larva (11 mm. long). The yield per hour, 23. October, at 2 stations, was 32 herring larvae of 7—12 mm. length.

Cod.

Danish Investigations.

In fishing experiments with the eel-tog conducted by the Danish Biological Station, cod were found to be very scarce at Møen. At Bornholm more 0-, II- and III-group cod were found than in 1949 (Table 3).

Table 3. Number of Cod caught per Hour in Eel-tog in 1950.

	Month	No. of Stations	Depth, m.	Age-groups 0	I	II	III	IV
At Møen	April	2	20—24	—	—	—	7	—
—	Aug.	3	17—23	2	2	—	—	—
—	Oct.	4	16—24	9	0.5	—	—	—
S. of Scania- at Bornholm	Aug.	7	17—96	24	7	6	5	0.6

AAGE J. C. JENSEN.

Swedish Investigations.

The stock of cod in the southern Baltic increased very much during the past decade, and gave rise to an intensive trawl-fishery. The strong year-classes from the years 1940—1943 are now very reduced, but in recent years new good year-classes have appeared (Ann. Biol. VI, 1949), and the stock of cod is still strong.

The catches of the trawl-fishery have fluctuated considerably, and this has, in some cases, been considered by the fishermen to be a result of overfishing. But the catches made with long-lines off the Swedish south coast have not shown any considerable variations and have often been larger than in the years before the intensive trawl-fishing began, thus indicating that the stock is not influenced to any great extent by the increased trawling.

The hydrographic observations in the Bornholm area show that the amount of oxygen in the bottom water is sometimes very low, and that may be a reason for the cod temporarily avoiding the usual trawling grounds in the deeper parts of the southern Baltic.

In some cases, however, there may have been other factors influencing the migrations of the cod. In the spring 1949, a quite informal co-operation was established between the Danish and Swedish research vessels "Biologen" and "Eystrasalt" enabling simultaneous catches to be made at different localities. The investigations showed some interesting features as to the distribution of the cod. In the deep water east of Bornholm the males formed the bulk of the catches while the females were predominant nearer the Swedish coast. The observations may indicate that the Baltic cod undertakes spawning migrations but that the two sexes do not arrive at the spawning places at the same time.

Earlier investigations by Hessle have shown that the cod, in the central Baltic, occurred principally on broken, rough bottom but very seldom on the smooth mud bottom. In January 1950 trawling experiments were carried out there on mud bottom at depths of about 100 m. east and west of Gotland. Large catches were obtained, showing that there was plenty of cod on the soft bottom of the central Baltic. This may have been due to the big increase in the density of the stock as a whole in this area necessitating part of the stock living on a not very suitable bottom.

Harald Alander.

Flat Fishes.

0- and I-Groups.

Danish Coasts.

The number of 0-group **plaice, flounder** and **turbot** caught in depths of $^1/_4$—2 m. are given in Table 4. The catches of 0-group plaice are also illustrated in Figure 1, p. 104. The Johansen young-plaice trawl used at Bornholm was not the same as that used on the other Danish coasts; it was of faulty construction (see p. 103) which was only partially corrected so that there was some doubt as to whether its fishing power was fully as great as that of the standard implements. It is seen that the number of all three species at Sjælland-Møen was very low but that the frequencies were, of the plaice about or a little above normal, of flounder very low and, of turbot, above normal.

Table 4. Number of 0-group of Plaice, Flounder and Turbot on the Baltic Area Coasts of Denmark.

Number caught per 1 hour by Johansen young-plaice trawl (J. Y.), (see text) and by hand push-net (H.P.). In brackets means for 1928—49.

	No. of stations	Plaice	Flounder	Turbot
Sjælland-Møen (J.Y.).	5	1 (5)	10 (394)	0 (0.6)
Bornholm (J.Y.).....	6	10 (27)	8 (90)	2 (12)
Bornholm (H.P.).....	15	20 (16)	77 (231)	58 (25)

Older Age-Groups.

Danish Investigations.

Fishing with the eel-tog (see cod, above) at Møen gave the following yields per hour: in April, no flat fishes; in August, 1.4 plaice (II- and III-gr.), 51 dab (37 I-gr., 11 II-gr. and 3 III-gr.) and 0.3 turbot; in October, 2 plaice (I-, II- and III-gr.), 8 dab (2 0-gr., 5 I-gr. and 1 II-gr.) and 0.2 flounder. To the south of Scania and at Bornholm 0.5 dab only were caught per hour (in August).

Aage J. C. Jensen.

Swedish Investigations.

In the central Baltic the turbot is fairly common, but in the Sea of Bothnia it occurs, as a rule, very seldom. In recent years, however, there has been a noticeable increase in the stock of turbot in the southern part of the Sea of Bothnia, and the fishermen have, in this district, obtained small but regular catches in

their bow-nets. The turbots caught were generally small and of fairly uniform size, 20—25 cm. in length. Probably the increase in the stock was due to the increase of salinity that took place in the previous years.

HARALD ALANDER.

Sprat.

Swedish Investigations.

The herring investigations in the Sea of Bothnia in 1950 were chiefly carried out with the new pelagic trawl. With this gear in conjunction with the echo-sounder it was possible to investigate fairly closely the behaviour of the herring and sprat shoals.

The investigations in the previous years had indicated that the stock of sprats had very much increased in the Sea of Bothnia, and the herring catches made with the ordinary gill-nets were, as a rule, more or less intermixed with sprat. The investigations with the pelagic trawl showed, however, that the herring and sprat shoals were not intermixed, but moved in somewhat different water layers. In June and July very large shoals of spawning sprats were found, generally 12—15 m. below the surface, in the vicinity of the Swedish coast of the Sea of Bothnia. Sometimes, however, the sprats did not form real shoals but appeared as a rather diffuse layer at the said depth. Herring were usually found at a depth of about 20—25 m., just on the distinct border between the warm surface water and the cold water below. Sprats, however, were always found within the surface water, and no connection could be traced between their vertical movements and the hydrographic conditions. The investigations indicate that the stock of sprats in the Sea of Bothnia is fairly large, and its reproduction in this district seems at present to be good, judging by the comparatively large number of small sprats in the catches. The conditions for sprats in the Sea of Bothnia seem to have improved in recent years, which may be due to the increasing salinity.

HARALD ALANDER.

Herring.

INTRODUCTION

This is the second report of the Herring Committee, to which the following scientists have contributed:—

1. Belgium ..... M. C. Gilis
2. Denmark ..... Dr. A. J. C. Jensen
   » ..... Dr. Å. V. Tåning
3. France ..... M. J. Ancellin
4. Holland ..... M. L. K. Boerema
   » ..... M. J. de Veen
5. Iceland ..... Dr. H. Einarsson
   » ..... Mr. Árni Friðriksson
6. Norway ..... Mr. O. Aasen
   » ..... Mr. F. Devold
7. Scotland ..... Mr. G. McPherson
   » ..... Mr. A. Saville
   » ..... Dr. H. Wood

No attempt is being made to summarize the present condition of the herring stocks or the scientific work, which has been carried out during the year. Some of the contributions have come in rather late, and were sent direct to Copenhagen; we further regret not to have received contributions from at least two countries.

The most important item on the programme has been the tagging, which we hope will be continued and extended in the years to come. It is also hoped that we may succeed in making the contributions to the herring report still more uniform in the future in order to express every essential feature without wasting too much space.

Árni Friðriksson.

REPORTS

A. Iceland—Norwegian Sea.

1. YOUNG STAGES

Occurrence of Larval Stages at Iceland, 1.-3. August 1950.

During the cruise of the "Dana" in northern waters, larval stages of the summer-spawning herring were met with in some abundance off the southern Icelandic coasts in seven localities where experiments were carried out. The maximum catch per 30 min. oblique haul with the 2-m. stramin net was about 2000 specimens, and this catch was secured off Westre Horn as in some other years (cf. A.B.I, 1943, p. 36 and Rapp. et Proc. Verb. Vol. 99, 1936, VI).

Å. Vedel Tåning.

Figure 1. Herring Larval Stages. 1.—3. August 1950.
• Larvae present, x larvae not present.
(See Table 1).

Table 1. Occurrence of Larval Herring. South Iceland. Size Distribution. "Dana" 1950.

(3×10 minutes oblique hauls with 2-m. stramin net, 400 strands per m.).

	Reykjanes		Selvogsbanki		Portland		Ingolfshøfdi	Westre Horn		
Stat no.	7325		7326	7327	7328		7329	7330	7331	
Date	1/8 50		1/8	1/8	2/8		2/8	2/8	3/8	
Hour	15^{17}		19^{40}	21^{57}	9^{05}		17^{41}	23^{37}	1^{23}	
N. Lat.	63° 42′		63° 37′	63° 31′	63° 20′		63° 46′	64° 13′	64° 08′	
W. Long.	22° 30′		21° 22′	20° 52′	18° 55′		16° 25′	14° 48′	14° 28′	
Depth m.	140		90	83	95		55	83	164	
Gear, Min.	S 200–30		S 200–30	S 200–30	S 200–30		S 200–30	S 200–30	S 200 -30	
Wire out m.	200–150–125	100–50–25	100–50–25	100–50–25	200–150–125	100–50–25	100–50–25	100–50–25	200–150–125	100–50–25
mm. 20	—	—	1	—	—	—	—	—	—	—
-	—	—	—	—	—	—	—	—	—	—
-	—	—	—	—	—	1	1	—	—	—
-	—	—	—	—	—	—	3	3	1	1
-	—	—	1	—	—	—	8	3	9	9
15	—	—	2	—	—	2	12	11	20	22
-	—	—	5	—	—	—	4	9	22	22
-	3	1	14	7	—	—	8	19	28	21
-	2	1	44	12	—	—	13	30	33	54
-	7	2	57	25	—	—	28	62	53	54
10	4	4	43	45	—	—	31	42	28	16
-	1	1	24	50	—	—	12	13	6	1
-	14	—	9	29	—	—	6	6	—	—
-	7	5	—	27	—	—	1	2	—	—
-	—	2	—	5	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—
No. measured	38	16	200	200	0	3	127	200	200	200
Total catch	38	16	335	1024	0	3	127	313	1476	2007
Av. size in mm. (corr. by +0.5)	9.71	9.44	11.45	9.81		16.50	12.11	11.89	12.73	12.92

5339

Larvae at Faroe. Scottish Survey. (See p. 27).

Herring larvae were taken on too few cruises to permit of a similar treatment to that given to haddock. Several points of interest arise from the data however. The largest numbers of larvae were taken in mid-April at two stations in the Sandö area. This is in general agreement with the spawning area and period suggested by TÅNING (1936). It should be noted, however, that whereas TÅNING suggests spawning within the 50-metre contour and close to land, in the present data the mean size of the larvae on Sandö Bank was significantly smaller than that of those on the plateau itself which would suggest that the former was nearer to the original spawning area. No accurate comparison can be made between the abundance of larvae from the present survey and from TÅNING's data as his are based on horizontal tows. There seems little doubt, however, that herring larvae were considerably more dense during the present survey than any previous data from Faroe have suggested. Assuming a uniform depth distribution of herring larvae the greatest catch from these data is twenty-five times the greatest reported by TÅNING who presumably towed at levels where these larvae were most abundant.

By May herring larvae were taken, in considerably smaller numbers, only on Nolsø Bank. These had a mean size of 14.5 mm. compared with 10.2 mm. in the previous cruise. It is significant that these sizes are very similar to those reported previously from Faroe for similar dates. It seems unlikely, however, that the two groups are products of the same spawning; to assume so would demand an extremely slow growth-rate of 0.0056 increase per day in the logarithm of the length. One can only assume that the second group was a product of a later spawning and that the first had either drifted out of the area or had been reduced to numbers too small to be detected, by May.

A. SAVILLE.

2. COMMERCIAL FISH

Occurrence of Herring North-East of the Faroe Islands, in June and August, 1950.

In 1950 herring were found scattered over large areas of the Norwegian Sea to the north-east of the Faroes up to about 160 nautical miles north and north-east of Enniberg. Over most of the area, however, the herring were thinly dispersed and were present only in comparatively small schools. Within an area lying between about 45 and 90 nautical miles from Enniberg, heavier accumulations of herring occurred. These were in the mixed-water area bounded by latitudes 62°55′N. and 63° 30′N. and longitudes 4° W. and 5° 30′W., i.e., around the "tongue" of the East Iceland Arctic current (see the hydrographical review by F. HERMANN in the North-Western Area report p. 13 *et seq.*).

In June, at any rate, this mixed-water area, where Atlantic and Arctic water meet, was continually subject to alterations; warm and cold layers of water intermingled, and accordingly, the areas in which the larger numbers of herring accumulated were constantly changing.

The herring preferred a depth of 15—35 m. and a temperature of 7°—8°C. In the purely Atlantic water (of high temperature and a salinity of about 35.3 ‰) herring, if found at all, occurred only sporadically. They were also scarce in the Arctic water (of low salinity and a temperature of about 3°—5°C.). On the other hand the herring were rather abundant on the eastern boundary of the cold current. The occurrence of herring is, however, probably highly dependent on the food conditions; where food is scarce, as in the barren water in the East Iceland Arctic current, the herring are absent. Probably in other years when food conditions are more favourable in the surface layers over the Arctic current, the herring will cross this current more abundantly and reach Icelandic waters.

Herring caught in June were almost exclusively big, spent (and consequently still lean) North Iceland herring of the Norwegian-Icelandic herring stock. In June the length averaged about 34.15 cm. and the weight just over 300 g. It seems that these herring, after spawning off Norway (and perhaps north of the Shetlands) in February-March, then disperse all over the southern part of the Norwegian Sea in search of food. A part of the herring (no doubt only a small fraction) get into the said "mixed-water" area and, for some time, they accumulate there between the Arctic current and the Atlantic current north of the Faroes. Later in the summer the herring disappear from this area (see below). In June about 6 % of the herring were ripe, and this fraction probably represented either Faroe or

Iceland summer-spawning herring. Small herring, probably of Norwegian or Faroe origin, also occur in this area; their proportion of the total can only be determined by experiments using small-meshed nets. In the drift-nets used—with meshes from 34 mm. down to 28 mm. (knot to knot)—the June catches contained only about 6 % of such small herring (24—30 cm. long); herring less than 24 cm. long were not caught.

In **June,** by echo-sounding, herring were observed over practically the whole of the investigated area; viz., at distances of up to 160 miles to the north and north-east of Enniberg. As mentioned earlier the smaller numbers of herring observed were in the Atlantic water near to the continental shelf and also in the colder part of the East Iceland Arctic current; the greatest number was in the mentioned "mixed-water" area. The usual occurrence is characteristically as dispersed "spots". Whether herring may be found still further to the north and north-east at this time of the year was not investigated by the "Dana".

At the beginning of **August,** 1950, the occurrence of herring was very different from that observed in June. Research work was carried out from east Iceland, along latitude 65° 20′ N. eastwards as far as longitude 3° W., from where we investigated the south of the North-Western Area towards the Faroes. At localities where the water of the cold current, of 3° C. or less, approached the surface at a depth of about 40—60 m., no herring were recorded by echo-sounding. However, everywhere in the section east of Seydisfjord that these conditions did not obtain, herring were observed. A sample was caught in drift-net and proved to be of herring of the Norwegian-Icelandic stock; in contrast to the herring caught in June, they were fat, about 34.45 cm. long and weighed about 340 g.

The herring were dispersed along the route eastwards along latitude 65° 20′N. in the following manner: close to east Iceland we found cold water, and no herring were recorded by echo-sounding; about 70 miles off east Iceland herring began to appear and were rather numerous over a stretch of about 60 miles (approximately from long. 11° W. to 9° W.); from there, about 130 miles east of Iceland, the cold current was crossed without any sign of herring (approx. between 9° and 7° W. long.), whereafter herring again began to appear, in greater numbers east of about longitude 5° 30′ W. On reaching longitude 3° W. the "Dana" took a southerly course, and we have accordingly no knowledge of how far east it would have been possible to trace the herring. South of latitude 65° N. practically no herring were observed. Sporadic traces of herring were still noted in the mentioned "mixed-water" area to the north-east of the Faroes, but the signs recorded were so diffuse and insignificant that we did not consider it worth while to shoot the nets, since, according to previous experiences, this would probably yield at most only a few herrings in return for each nightly effort. Evidently, by this time the herring had migrated north or north-westwards.

In 1948, the "mixed water" was present to the north-east of the Faroes at the beginning of August and at that time of that year herring were still fairly plentiful. Later in August, however, they left the area owing to increasing amounts of warm Atlantic water. In 1949, according to the Faroe fishing vessels, the herring disappeared in July but no research work was undertaken by the "Dana" during that year. In 1950, according to information from fishing vessels, the herring disappeared as early as the middle of July.

Å. Vedel Tåning.

The Southern Icelandic Herring during 1950.

A. Commercial.

The herring fishing in the south-western coastal waters began in the second half of August. The fishing began in Grindavíkursjór and the main fishing of the season occurred there and in Miðnessjór.

The number of fishing vessels engaged in this fishery was as follows:—

	Aug.	Sept.	Oct.	Nov.	Dec.
Vessels:	30	144	166	103	56

All the vessels used drift-nets, experiments with other gears being of no avail.

A total of 204,078 barrels (1 barrel = approximately 1 hl.) were fished during the season. Of this total, 131,708 barrels were salted, 63,657 barrels prepared as frozen bait and 8,713 hl. were received by the herring oil factories.

B. Behaviour.

The shoals occurred mainly in mid-water, in about 40—60 m. depth, and remained mostly outside the reach of the drift-nets.

Occasionally the shoals rose towards the surface, especially during the night. Because of this peculiarity in the behaviour of the herring on the fishing grounds the total catch was small.

C. Racial Analyses.

23 samples of herring, each comprising about 200 specimens, were investigated during 1950. A total of 5504 specimens was examined.

The seasonal races were distinguished by means of the otoliths and the stages of maturity. Table 2 shows the result of these analyses. Details are given of vertebral numbers of the different year-classes present in the samples. The values show a close agreement with those found previously.

In Table 3 a comparison is made between the vertebral numbers of the two seasonal races. It will be seen that the values have been

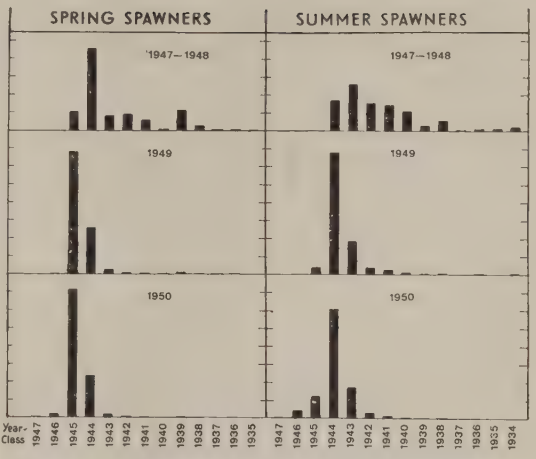


Figure 2. Age Distribution of Southern Icelandic Herring.

Table 2. The Southern Icelandic Herring arranged according to Race.

Details are shown of year-classes, number examined (No.), vertebral numbers, age distribution (%), mean vertebral number (M), standard deviation (δ) and standard error of the mean (m).

Spring Spawners

Year-Class	Rings	Vert. S. 60	59	58	57	56	55	54	Total No.	%	M	δ	m
1947	3+	—	—	3	16	—	—	—	19	0.5	57.158	0.365	±0.083
46	4+	—	—	25	43	5	—	—	73	2.0	57.274	0.579	±0.068
45	5+	1	28	814	1578	248	3	2	2674	71.6	57.229	0.632	±0.012
44	6+	—	9	274	510	69	5	1	868	23.2	57.242	0.641	±0.022
43	7+	—	—	20	38	4	—	—	62	1.6	57.258	0.566	±0.071
42	8+	—	—	5	15	4	—	—	24	0.6	57.041	0.611	±0.125
41	9+	—	—	—	6	4	—	—	10	0.3	—	—	—
40	10+	—	—	—	—	1	—	—	1	0.0	—	—	—
39	11+	—	—	1	1	—	—	—	2	0.1	—	—	—
38	12+	—	—	1	1	—	—	—	2	0.1	—	—	—
37	13+	—	—	—	—	—	—	—	—	—	—	—	—
36	14+	—	—	—	1	—	—	—	1	0.0	—	—	—
Total No.		1	37	1143	2209	335	8	3	3736	100.0	57.230	0.632	±0.010

Summer Spawners

1947	2+	—	—	—	2	3	—	—	5	0.3	—	—	—
46	3+	—	—	5	52	25	—	—	82	4.6	56.757	0.554	±0.061
45	4+	—	—	28	151	45	1	—	225	12.7	56.916	0.579	±0.038
44	5+	—	3	135	739	185	2	1	1065	60.3	56.952	0.570	±0.017
43	6+	—	4	42	198	60	1	—	305	17.3	56.961	0.632	±0.036
42	7+	—	—	7	34	12	1	—	54	3.0	56.870	0.639	±0.087
41	8+	—	—	2	15	5	—	—	22	1.2	56.864	0.548	±0.116
40	9+	—	—	1	6	—	—	—	7	0.4	—	—	—
39	10+	—	—	1	—	—	—	—	1	0.1	—	—	—
38	11+	—	—	—	2	—	—	—	2	0.1	—	—	—
37	12+	—	—	—	—	—	—	—	—	—	—	—	—
36	13+	—	—	—	—	—	—	—	—	—	—	—	—
35	14+	—	—	—	—	—	—	—	—	—	—	—	—
Total No.		—	7	221	1199	335	5	1	1768	100.0	56.936	0.585	±0.014

Table 3. Comparison of Vertebral Numbers of the two seasonal Races of Icelandic Herring during 1947 to 1950.

	60	59	58	57	56	55	54	53	No.	M	δ	m
Spring Spawners												
1947/48.....	—	31	870	1763	273	8	4	—	2949	57.214	0.636	±0.012
1949.....	—	22	810	1627	217	5	—	—	2681	57.234	0.607	±0.012
1950.....	1	37	1.143	2209	335	8	3	—	3736	57.230	0.632	±0.010
Summer Spawners												
1947/48.....	—	13	513	2109	734	26	5	2	3402	56.921	0.621	±0.011
1949.....	—	7	597	2941	749	17	3	—	4314	56.959	0.581	±0.009
1950.....	—	7	221	1199	335	5	1	—	1768	56.936	0.585	±0.014

fairly stable during recent years, and that the values found in 1949 and 1950 were almost identical. This was to be expected since new year-classes were extremely insignificant. The low V. S. of the summer spawners during 1950 is easily explained by the fact that the 3-ringers which came on to the fishing grounds have a very low average vertebral number. If we exclude the 2- and 3-ringers, which were not present during 1949, the vertebral numbers are as follows:

No. of V.	54	55	56	57	58	59	Total	M	m
Number:	1	5	307	1145	216	7	1681	56.947	±0.014

This average number agrees excellently with that found in 1949.

An outstanding feature of the composition of the catches during 1950 is that the spring spawners constituted the major part of the catches—on an average 67.9 %. The reverse was true for the year 1949 when the spring spawners constituted only 38.3 % of the total as against 61.7 % of summer spawners. This seems to indicate that our samples are not representative of the stock as a whole, especially as new year-classes that could have altered the relative strength of the two seasonal races did not, in fact, appear. Therefore it seems safe to conclude that we are at present only fishing on the fringes of the stock.

D. Age Distribution.

The age distribution during the years 1947—1950 is shown in Figure 2, the details for 1950 being given in Table 2. During 1947—1948 the year-classes from the summer of 1943 and spring of 1944 were dominant, but in the latter half of 1948 there occurred a great change in the age composition of the catches. The year-classes from the summer of 1944 and the spring of 1945 then entered the fishery and these have subsequently constituted the main part of the catch, viz., between 60 and 70%.

It will be seen that the age distribution during 1950 was very similar to that found during 1949. No new year-classes appeared in the spring spawning stock, while the 4-ringers of the summer spawning stock were of only small importance, constituting 12.7 %. Judging from our experience during 1949, the 4 ringers should show their strength in this area. The fact that they were of little significance during 1950 seems to indicate that the broods from the summer of 1945 and spring of 1946 are relatively poor. HERMANN EINARSSON.

On the Herring and the Herring Fishery of the North Coast of Iceland during the Summer of 1950.

In the large summer herring fishery off the north coast of Iceland only two gears are used, purse seine and drift-nets. By far the largest part of the catches is taken by purse seine, the yield of drift-nets being a negligible fraction of the total catch.

In Figure A a survey is given of the number of seines employed from year to year and the average catch of herring per seine during the period 1940—1950. It appears clearly that the

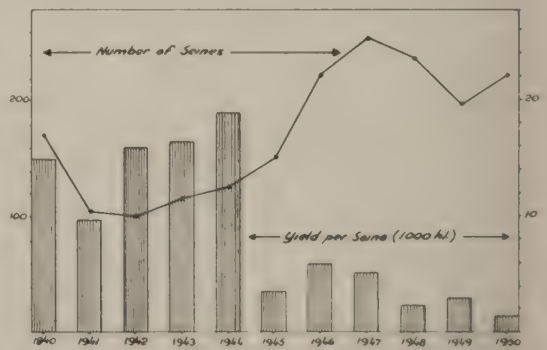


Figure A. Number of Purse Seines employed at the north coast of Iceland and the Annual Yield per Seine (1000 hl.) during the Period 1940 to 1950.

yields were extremely low during the latter half of the period (1945—1950) and reached a minimum in 1950. In that year 221 seines were operated by 225 vessels. The average catch per seine amounted to 1500 hl. only and the total yield of the north coast fishing was 326,833 hl. Some of the vessels did not catch a single herring and 3 or 4 reduction plants got no material at all. The best year of this period (1944), on the other hand, gave an average of about 19,000 hl. per seine.

There was another striking feature in connection with the bad fishing. The yields did not come from the whole area off the north coast as they used to do in a "normal" year, but were mainly limited to the most easterly part of the coast. This is shown in Figure B. If we consider the yields per sub-areas (see map on pag. 163, Ann. Biol. Vol. VI), we find that the western sub-area (V), which is by far the largest, only yielded 1%, the yields of M, E_1 and E_2 being 3, 31 and 64% respectively. — It must be pointed out that the statistics, upon which this information is based, do not cover the entire fishing fleet.

26 samples of herring were investigated (2600 herrings), 5 of which originated from sub-area V, 5 from M, 11 from E_1, and 5 from E_2.

Table I gives a survey of the size-distribution. The herring was considerably larger than

Table I. The Length of the North-Coast Herring in 1950, according to Areas (‰).

Cm.	V	M	E_1	E_2	Total
40	—	2	—	—	+
39	10	4	2	—	3
38	80	24	7	6	24
37	212	182	104	48	129
36	312	314	337	236	309
35	210	286	365	374	321
34	82	112	136	170	128
33	64	60	32	98	57
32	22	14	16	46	23
31	8	—	—	8	3
30	—	2	—	10	2
29		—	—	—	—
28	—	—	—	4	1
27	—	—	1	—	+
Total:	1000	1000	1000	1000	1000
N	500	500	1100	500	2600
M	35.70	35.49	35.31	34.74	35.33

normal being 35.33 cm., or more than 0.40 cm. above the normal and 0.13 cm. above the average of the preceding year. Keeping in mind that the major part of the material investigated (68.8%) originated from the sub-areas E_1 and E_2 where we usually have the smallest herring, the increase in size becomes still more striking. As in the general rule we still have a clear size decrease from west to east, the average lengths being as follows: Sub-area V, 35.70 cm.; M, 35.49 cm.; E_1 35.31 cm.; and E_2 34.74 cm.

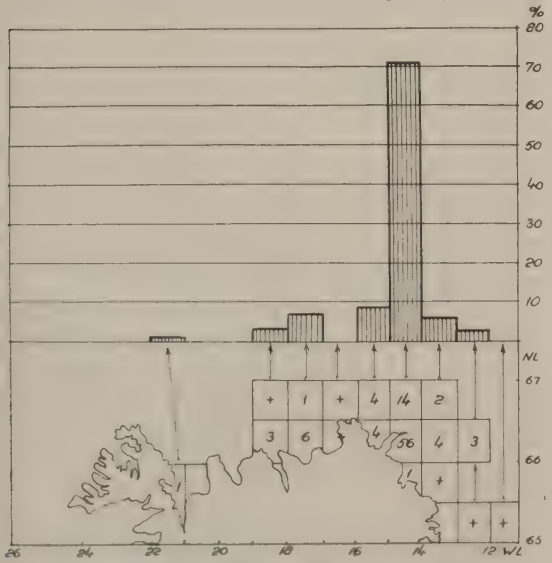


Figure B. Distribution of Catches during the Summer of 1950 (July—August). The figures indicate the percentages of the total yield, taken in each rectangle.

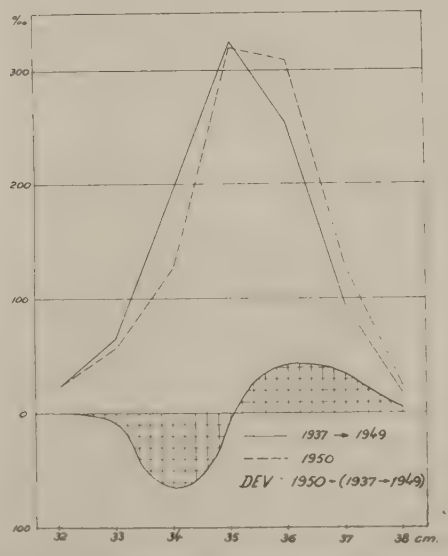


Figure C. Size Distribution of North-Coast Herring in 1950, the Normal Size Distribution (1937—1949) and Deviation from Normal.

Table II. The Tribes in the North-Coast Herring according to the Structure of the Scales.

Age Composition.

Age	Brood	Atlanto-Scandian N-type	Atlanto-Scandian S-type	Atlanto-Scandian Total	Icelandic Herring Spr.	Icelandic Herring Sum.	Icelandic Herring ?	Icelandic Herring Total	Uncertain	Grand Total
3	1947	—	—	—	23	—	20	18	2	2
4	1946	—	14	4	23	75	10	26	—	5
5	1945	2	62	20	326	200	127	214	18	37
6	1944	7	105	36	256	125	98	159	11	43
7	1943	19	103	45	139	100	118	121	9	46
8	1942	13	65	29	58	175	146	115	23	36
9	1941	20	98	44	58	75	98	83	15	42
10	1940	25	110	51	12	100	118	75	15	47
11	1939	51	69	60	35	100	108	79	13	51
12	1938	138	77	120	23	25	78	48	18	96
13	1937	220	82	184	—	—	10	4	39	140
14	1936	126	58	102	12	—	20	16	20	83
15	1935	169	64	134	12	25	29	22	11	106
16	1934	119	48	95	23	—	10	16	9	75
17	1933	55	26	46	—	—	10	4	4	35
18	1932	19	5	15	—	—	—	—	4	12
19	1931	7	7	7	—	—	—	—	—	3
20	1930	2	2	1	—	—	—	—	—	1
21	1929	1	—	1	—	—	—	—	—	+
R	—	—	—	—	—	—	—	—	108	15
?	—	7	5	6	—	—	—	—	681	123
Total.....		1000	1000	1000	1000	1000	1000	1000	1000	1000
N.....		1335	584	1919	86	40	102	228	452	2599

As already emphasized the length of the north-coast herring has been increasing during recent years. A glance at Figure C will give an idea of the surplus of large herring in this year. There is evidently less of all fish smaller than 35 cm. and relatively more fish in the higher size-classes (over 35 cm.) than normally.

2599 herrings were examined for age and the result is shown in Table II. The ages range from 3 to 21 years, comprising 19 year-classes, the broods from 1929—1947 included. There are only two dominating year-classes, those 13 and 15 years old, originating from 1937 and 1935. They make up about a quarter of the total yields. The strongest one is the brood from 1937, (13-year-old fish) contributing 14.0% against 17.7% in 1949.

As shown on Table II 452 scales were not suitable for reading age or distinguishing type. Of the remainder, which comprises 2147 herrings we find 1919 fish belonging to the Atlanto-Scandian tribe and 228 being of Icelandic origin. In the first-named category we can distinguish between a northern and a southern type, while the Icelandic herring consists of two other types, spring- and summer-spawning herring. We find 102 herrings which can neither be reckoned as northern or southern type of the Atlanto-Scandian stock. They resemble Icelandic herring in the structure of the scales but cannot with certainty be classified as spring- or summer-spawners.

If we now ignore the uncertain 452 herrings we come to the following conclusion as to the composition of the stock:

1) 62.3% (1335) Atl.-Scand. herring of the northern type.
2) 27.2% (584) Atl.-Scand. herring of the southern type.
3) 4.0% (86) Icelandic spring-spawning herring.
4) 1.8% (40) Icelandic summer spawners.
5) 4.7% (102) Icelandic herring, not distinguishable as to spawning type.

As in the previous year, the Atl.-Scand. herring has made up the overwhelming bulk of the catch in 1950. The northern type is the main contributor, making up over 60% of the whole yield and the dominating year-classes in the total catch are due to this part of the stock. As will be seen from the table much younger dominants are found in the southern type (6-, 7- and 10-year-old fish) and in the insignificant Icelandic tribes (5-, 6- and 8-year-olds).

As could be expected when the age is considered the Icelandic herring is much smaller than the Atl.-Scand. one. This appears clearly from the following figures, where a

comparison is made between the northern type (N.T.), the southern type (S.T.), both types combined (comb.), and all Icelandic herring (Icel.).

Cm.	N.T.	S.T.	Comb.	Icel.
>36	16.0	10.3	14.3	7.0
36	37.3	23.8	33.2	14.0
35	34.9	32.5	34.2	25.0
34	9.4	19.0	12.3	19.3
<34	2.4	14.4	6.0	34.7
Total %	100.0	100.0	100.0	100.0
M, cm.	35.57	34.91	35.37	34.22

In the case of the Atl.-Scandian stock the average size is 35.37 cm., only 6% are smaller than 34 cm., 79.7% measure 34—36 cm. and 14.3% are larger, the corresponding figures for the Icelandic stocks being 34.22 cm., 34.7%, 58.3% and 7%.

ÁRNI FRIÐRIKSSON.

Norwegian Investigations.

A. General Work.

During the year 1950 60 herring samples, each comprising about 200 herrings, were collected, and the total number, 12,000 individuals, has been examined at our institute as for length, weight, age, growth, stomach and fat content.

The age distributions of the winter herring for the years 1946—50 are given in Figure 3. One of the illustrations represents the "large herring" from samples taken at the beginning of the season and mainly caught north of Bergen. The other age frequencies are of the "spring herring", the samples of which were collected during the actual spawning season at localities mainly south of Bergen. The age distributions seem to indicate that there is a real difference between the "large herring"

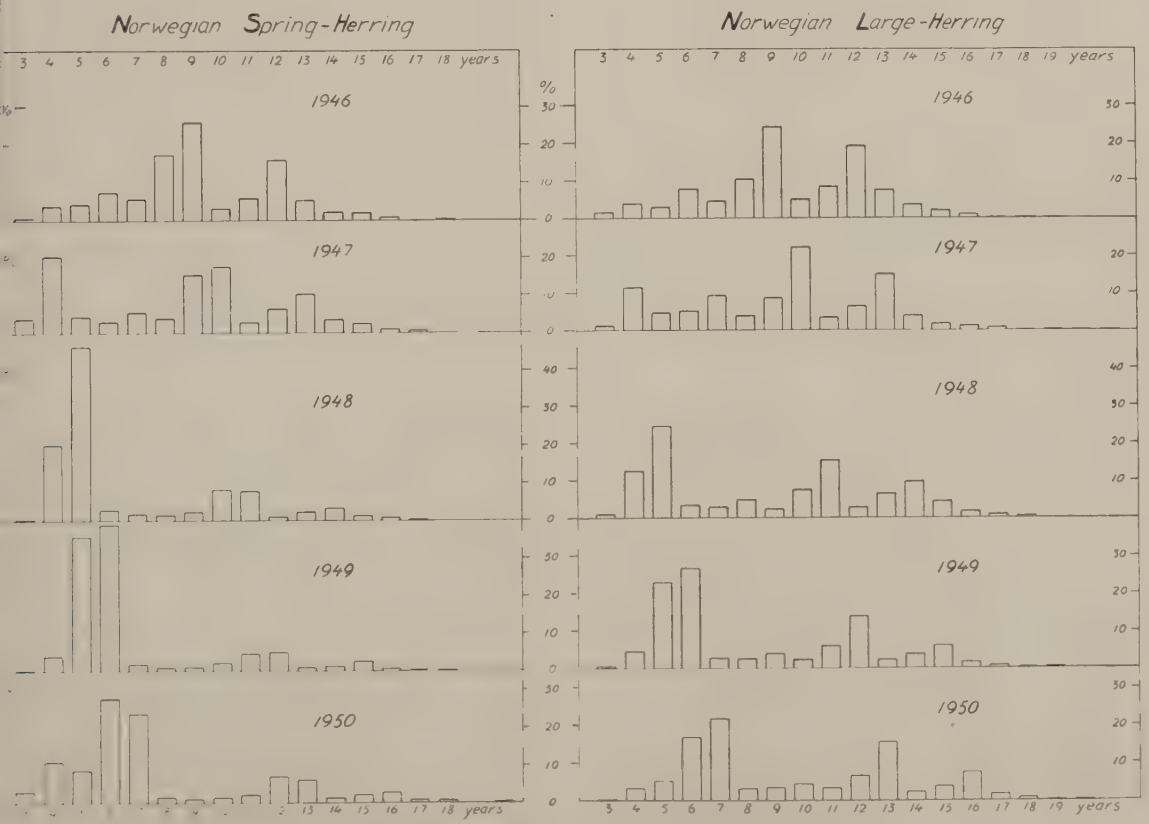


Figure 3. Age Distribution of the Norwegian Winter Herring.

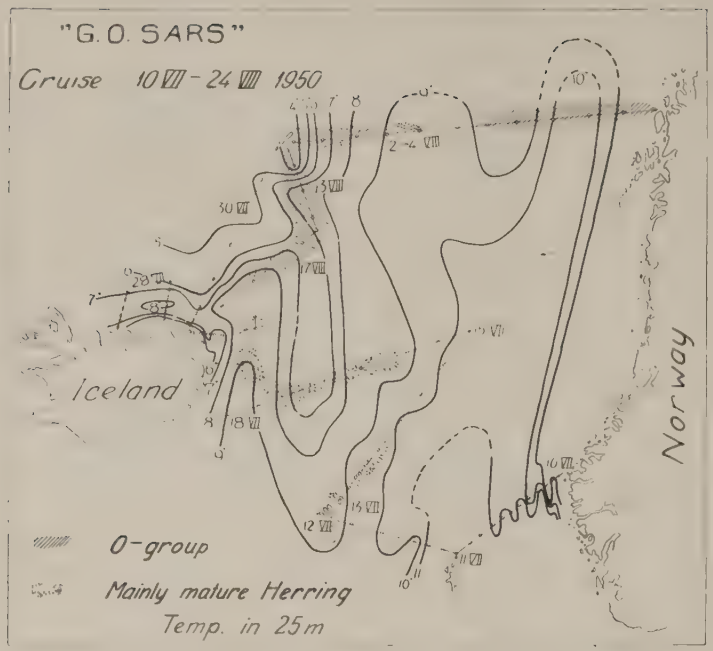


Figure 4.

and the "spring herring" as to age frequency, although they both seemingly belong to the same tribe. The reason for the difference is likely to be found in the facts that the arrival of the recruit spawners in the coastal waters is later than that of the older herrings, and that they complete their spawning later. The young year-classes will, therefore, predominate in the "spring herring". It is still a problem as to which of these two age frequency compositions is to be regarded as being representative of the total tribe of mature herring. It is most likely that neither of them give the correct picture of the age distribution. At the moment, however, we have no better information.

Besides doing routine work in the coastal waters, the R/V "G. O. Sars" made two cruises in the open ocean with the main purpose of locating the whereabouts of the herring schools outside the spawning season. During the first cruise, 10. July to 24. August 1950, large areas of the Norwegian Sea were investigated. The map in Figure 4 shows the main route followed and also the hydrographic sections worked: plankton samples were also taken on the sections. The dotted areas indicate the positions where herring were found, the width of the dotted areas giving a measure of the number of schools located by use of asdic in one hour when the ship was cruising at 10 knots. In the western part of the ocean we found mainly mature herring. The hatched areas off north Norway give the positions in which mainly herring of the 0-group were located. The 0-group herring were registered by asdic and echo-sounding and could also be observed at the surface in great quantities. We had no suitable gear for catching these herring, but with large-meshed drifts-nets we obtained a few of the larger herring, and on examination their stomachs proved to be full of small herring of the 0-group.

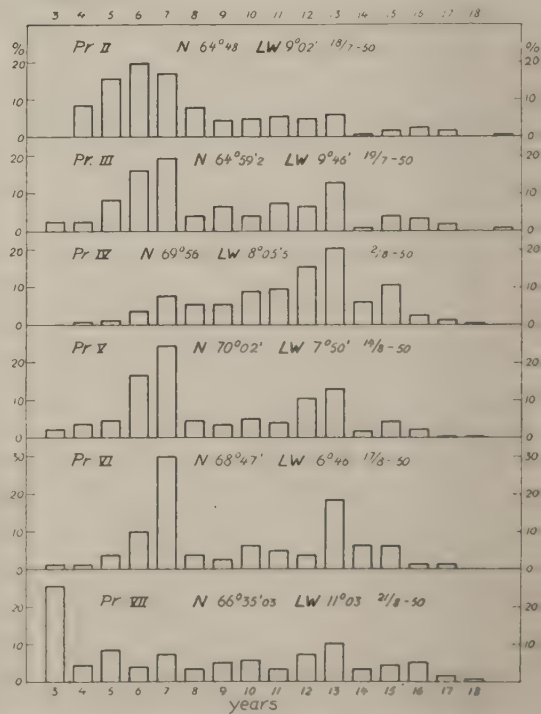


Figure 5. Age Distribution of Herring. Samples from the »G. O. Sars« Cruise, 10. July to 24. August 1950.

The map also shows the temperatures at a depth of 25 m. Due to the great distances between the stations and to the time taken in covering the whole area, the locations of the isotherms will be a little inaccurate.

During the cruise 7 herring samples were secured from the catches. Figure 5 shows the age distribution in 6 of the samples and the positions and dates of capture. We think it is safe to conclude that all samples consist mainly of herring belonging to the Norwegian tribe.

In the last part of July the herring were located east of Iceland, and later in the summer most of the schools were gathered in the area north and east of Jan Mayen.

During the cruise from 8. December 1950 to 23. January 1951, we tried to locate the herring on their approach to the Norwegian coast for spawning. On 15. December great herring concentrations were found by use of asdic and echo-sounding north of the Faroe Isles, in the cold water reaching southwards between Iceland and Jan Mayen. We succeeded in keeping contact with the herring schools on their eastwards migration until they entered the Norwegian coastal waters on 22. January 1951. Samples taken with purse-seine and drift-nets have, as yet, not been worked up.

FINN DEVOLD.

B. Tagging Experiments.

In the year 1950 a total of 20,300 herrings were tagged at six different localities on the Norwegian coast. Out of these 9085 were liberated on the large herring grounds and 11,215 in the spring herring district. In addition 506 herrings were tagged on the summer cruise of R/V "G. O. Sars" on the 19. July at position 64°48′N. 09°02′W. Only internal steel tags were used.

In the same year 67 recaptures were made. Of these, 17 were from the taggings in the Karmøy region in the spring of 1948, 11 from the taggings at Iceland in the summer of 1948, 35 from the taggings in the spring herring district in 1949 and 7 from the 1950 taggings.

OLAV AASEN.

C. Special Investigations.

A "new" local herring race was discovered in the Lusterfjord, one of the innermost branches of the Sognefjord on the west coast of Norway. Some 1500 specimens, caught at different times of the year, have been examined as to length, weight, age, maturity stage, fat and stomach content etc. We have succeeded in establishing the maturity cycle of a spring spawning herring community, and data are being accumulated to throw light on such obscure questions as the production of rich and poor year-classes, the building up and breaking down of intestinal and muscle fat during the year etc. Fortnightly plankton samples and hydrographical observations have been collected in the fjord.

OLAV AASEN.

B. North Sea and Channel.

1. YOUNG STAGES

At Scotland.

0- and I-group, 1949-50.

The racial characters of the trawl-caught young herring (0- and I-group) from the bays of the Scottish east coast (Table 4) show that the samples from St. Andrew's Bay, Lunan Bay, and Aberdeen Bay consisted almost entirely of western North Sea autumn spawners. The Vert. S. counts for the Firth of Forth samples are typical of the same stock, but the K_2 values are low. This may be a local variation in the K_2 since a similar Vert. S.—K_2 pattern was found in the Firth of Forth samples for 1948—49. Two of the samples — Aberdeen Bay, February and March 1950 — were from the 1947 autumn year-class, the remainder were 1948 autumn brood.

The catch per hour suggests that the numerical strength of the brood hatched in the autumn of 1948 was about half of that derived from the spawning in the previous autumn.

Period	Hours Fishing	Total Catch	Catch per Hour
Nov. 1948—Mar. 1949	46	3,698 herring	80.3
Nov. 1949—Mar. 1950	39¾	1,631 herring	41.0

The racial characters of the I-group herring caught by drift-net (Table 5) show that

Table 4.

Length and Racial Characters of Young Herring (0- and I-Group) caught by Trawl by Research Vessels in Inshore Waters of the Scottish East Coast.

(numbers in brackets)

Month, Year.	Range cm.	Mean Length cm.	Vert. S.	K_2
Firth of Forth.				
Nov., 1949	8—15	11.5 (198)	56.46 (176)	14.34 (179)
Mar., 1950	11—17	13.4 (83)	56.31 (54)	14.35 (55)
Aug., 1950	15—21	17.8 (147)	56.51 (136)	14.52 (133)
St. Andrew's Bay.				
Nov., 1949	9—13	10.6 (253)	56.40 (238)	14.67 (237)
Mar., 1950	9—16	12.1 (318)	56.44 (210)	14.58 (209)
June, 1950	10—16	12.6 (115)	56.19 (21)	14.86 (22)
Lunan Bay.				
Nov., 1949	9—14	10.5 (238)	56.35 (227)	14.80 (205)
Mar., 1950	9—12	10.5 (26)	56.16 (25)	14.67 (24)
Aberdeen Bay.				
Nov., 1949	9—14	11.4 (55)	56.26 (50)	14.80 (49)
Feb., 1950	14—24	18.9 (52)	56.58 (36)	14.58 (36)
Mar., 1950	13—21	16.5 (49)	56.35 (46)	14.60 (43)
May, 1950	10—18	13.4 (478)	56.37 (51)	14.55 (60)

autumn spawners form the bulk of the samples, but the proportion of spring spawners appears to be higher than among the 0-group herring samples of 1948—49 (see Annales, Vol. VI, p. 170).

Table 5.

Length and Racial Characters of I-group Herring caught by Drift-Net in Inshore Waters of the Scottish East Coast.

(numbers in brackets)

Month, Year.	Range cm.	Mean Length cm.	Vert. S.	K_2
Firth of Forth.				
Jan.-Mar., 1950	20—25	22.7 (120)	56.59 (116)	14.35 (119)
Moray Firth.				
Nov., 1949	18—24	22.1 (206)	56.57 (202)	14.49 (198)
Dec., 1949	18—24	21.2 (247)	56.58 (236)	14.51 (247)

G. McPherson.

Young Herring off Esbjerg.

As in 1949 there was, in the Grådeep at Esbjerg during the summer months, a fishery for young herring for processing. The mean length of these herrings on 7. August was 10.5 cm.; this was a little more than at the corresponding time in 1949 (8.1 cm.). The racial characters given below were the same in the two years, and it is evident that the herring were autumn spawners from the western North Sea.

Racial Characters of Young Herring caught at Esbjerg.

(In brackets: No. of specimens examined).

	V.S.	V.P.	K_2
1949:	56.55 (263)	23.80	14.79 (318)
1950:	56.47 (230)	23.63	14.81 (110)

Aage J. C. Jensen.

2. COMMERCIAL FISH

The Scottish Fisheries. Adult Herring.

The Scottish North Sea herring fisheries began with landings by a few drifters in March and April from the neighbourhood of the Coral Bank. In May the drifter fleets were operating mainly within a range of 40 or 50 miles from the landing ports of Lerwick, Fraserburgh and Peterhead. The fishery extended until the first week in September although during August many vessels had adopted seine-net fishing for white fish.

The trawl fishery on the Fladen Ground continued from the last week of July until about the end of October.

Commercial landings from the North Sea were sampled at more or less regular intervals and an extensive programme of sampling was carried out in collaboration with Millport oceanographical team on the catches landed at Fraserburgh. Much material was also collected by "Clupea" during exploratory surveys of the herring grounds of the north-western North Sea.

Some attention was given also to the herring of the Firth of Forth and opportunities were taken to sample herring of the 0- and I-groups in the estuaries and coastal waters. Several samples of ring-net catches made in the Clyde estuary were examined. Tagging experiments with four types of tags were undertaken on "Clupea" and on commercial fishing vessels.

Summaries of Samples according to Area and Season.

Summaries have been prepared according to place and time of capture. Samples, from any one region and for any period or phase of the fishery, which have shown closely similar features, have been combined. All data, except race data, have been expressed in percentages. Age is denoted by the number of winter rings on the scales.

Samples from the Coral Bank March-April. Size Distribution.

24	25	26	27	28	29	30	31	32 cm.	No. of Fish
0.6	2.0	6.1	20.8	*43.0*	24.3	2.6	0.3	0.4	501

Maturities.

I	II	III	IV	V	VI	VII	VII-II
4.5	3.1	2.1	0.4	0.2	0.8	49.9	39.0

Age Composition.

Winter Rings.

2	3	4	5	6	7	8	9	10+
0.2	10.7	5.7	12.0	12.0	*23.1*	*19.5*	11.7	5.2

Vert. S.

Maturity.	55	56	57	58	Total	Mean
I	—	4	11	7	22	57.14
VII & VII-II ...	10	209	196	21	436	56.52

From the above data it is clear that the herring stock in the neighbourhood of the Coral Bank in March-April consisted predominantly of relatively old fish, the dominant year-classes having seven and eight winter rings on the scales. This fact should be kept in mind by the reader when considering the Shetland material, the later samples from the Scottish north-east coast and the material from the Fladen Ground. The vertebral counts of the few immature fish in the samples are typical for immature herring of the more northerly North Sea and clearly indicate their origin from spring spawning stock. It is equally clear that the fish grouped under maturities VII and VII-II belonged predominantly, if not quite exclusively, to autumn spawning stock.

Shetland.

The Shetland fishery in 1950 showed features similar to that of 1949. Relatively good catches were landed in May and early June but thereafter catches declined on the whole and in July many vessels left the area or undertook other methods of fishing. The following is a summary of herring landings in 1949 and 1950.

Year.	16. May—1.-2. July Arrivals.	Landings (crans).	2.-3. July—27. Aug. Arrivals.	Landings (crans).
1949	2,642	39,960	1,907	33,661
1950	2,351	36,714	1,010	16,396

Sampling was carried on from 1. June to 11. July and during that period no conspicuous change was apparent in the composition of the catches. The following summarizes the data.

Shetland Samples. 1. June—11. July. Size Distribution.

22	23	24	25	26	27	28	29	30	31	32 cm.	No. of fish
0.1	0.5	2.0	7.3	13.0	17.5	*29.3*	22.1	6.0	1.6	0.6	927

Maturities.

I	II	III	IV	V	VI	VII	VII-II
4.7	62.5	17.3	2.4	0.4	0.4	—	12.3

Age Composition.

Winter Rings.

2	3	4	5	6	7	8	9	10+
0.4	14.9	15.5	*22.1*	14.5	15.5	10.0	4.8	2.2

Vert. S. All Maturities.

55	56	57	58	59	60	Total	Mean
6	163	200	39	3	1	412	56.69

The dominant age-group, with five winter rings, came into some importance on the Scottish north-east coast in late July and August, but, as will be seen later, it was more conspicuous on the Fladen Ground during the autumn, and this fact assumes some significance when it can be recorded that all four recoveries of herring tagged in Shetland waters in June have been made on the Fladen Ground in late July and August.

The vertebral counts clearly indicate a stock of mixed origin, including both spring and autumn spawners.

The Scottish north-east coast.

The fisheries at the north-east ports showed two very distinct phases. From May until about mid-July the catches consisted predominantly of young fish, while later, more especially in August, relatively old fish formed the bulk of the catch. Data have been arranged according to these phases.

The following is a summary of herring landings at Fraserburgh and Peterhead in 1949 and 1950.

Date	Fraserburgh. Arrivals.	Landings (crans)	Peterhead. Arrivals.	Landings (crans)
1949				
9. May—16. July	5,427	52,079	3,183	29,001
17. July—27. Aug.	2,268	24,494	1,105	17,069
1950				
15. May—15. July	2,643	38,118	924	13,112
16. July—9. Sept.	2,270	32,360	1,240	14,810

The following summaries of data are based entirely on samples of commercial catches.

Summary of Samples collected between 30. May and 11. July.

Size Distribution.

22	23	24	25	26	27	28	29	30 cm.	No. of Fish.
0.3	6.5	27.0	*32.9*	18.0	7.9	5.5	1.7	0.3	1,772

Maturities.

I	II	III	IV	V	VI	VII	VII-II
16.5	52.9	12.9	2.9	0.3	0.1	0.1	14.2

Age Composition.

Winter Rings.

2	3	4	5	6	7	8	9	10+
12.8	*60.5*	14.2	5.6	2.6	2.7	1.3	0.3	0 1.

Vert. S. 3 Ringers 30. May—11. July.

Maturity	55	56	57	58	59	Total	Means
I & II	27	337	307	56	5	732	56.56
VII—II	7	73	68	2	—	150	56.43
IV—V	6	90	64	10	—	170	56.46

Samples collected between 18. July—25. August.

Size Distribution.

22	23	24	25	26	27	28	29	30	31 cm.	No. of Fish
0.1	0.7	3.6	11.2	12.1	10.9	13.2	*31.8*	15.1	1.4	1370

Maturities.

I	II	III	IV	V	VI	VII
0.5	13.9	15.5	15.3	28.3	3.8	22.7

Age Composition.

Winter Rings.

2	3	4	5	6	7	8	9	10+
13.3	12.3	9.4	11.5	9.7	*13.1*	*21.1*	4.1	5.4

Age Composition of Maturity Stages VI and VII 8.—25. August.

Winter Rings.

2	3	4	5	6	7	8	9	10+	No. of Fish
0.5	3.4	2.1	9.5	12.1	*18.5*	*33.2*	9.2	11.4	379

The change which took place in the composition of the herring shoals off the Scottish north-east in July is clearly demonstrated in the size distribution and age composition of the samples collected before and after 11. July. It may be pointed out that 7 and 8 ringers (year-classes autumn 1942 and 1941 respectively) had been recorded in appreciable numbers previous to 11. July only in the region of Shetland and the Coral Bank.

The 3 ringers, which were so conspicuous in the catches during the earlier phase of the fishery, did not come into prominence in the Scottish spawning shoals which were sampled. Nevertheless vertebral counts clearly indicate their origin from autumn spawning stock, and it is presumed that their spawning ground lay elsewhere.

The Fladen Ground.

The trawl fishery for herring on the Fladen Ground commenced in the last week of July and extended until the end of October. Both landings and unit catch fell below those of 1949.

Fishing hours.	Total catch (crans).	Catch per 100 hours fishing.
6,123	10,375	169.4

Normally the catches from the Fladen Ground in late July and in August consist predominantly of fish at maturity stages IV and V. From early September until the end of October they consist predominantly of spent fish — stage VII.

The following is a summary of data collected during 1950:—

Size Distribution.

Date	21	22	23	24	25	26	27	28	29	30 cm.	No. of Fish
15. Aug.	0.8	—	—	0.8	1.6	18.1	18.9	*41.7*	18.1	—	127
15. Sept.-15. Oct.	—	—	—	0.5	1.1	5.7	10.5	*33.0*	*39.7*	9.5	511

Maturities.

	I	II	III	IV	V	VI	VII
15. August.....	2.4	1.6	10.2	28.4	55.9	—	1.6
15. Sept.—15. Oct.....	1.0	0.5	9.2	7.2	4.9	—	77.2

Age Composition.

Winter Rings.

	1	2	3	4	5	6	7	8	9	10+
15. Aug.....	0.8	—	6.3	13.4	*16.5*	*24.4*	*20.6*	7.1	7.9	3.2
15. Sept.—15. Oct. (all stages)	—	1.7	6.3	10.1	*17.1*	13.9	*15.3*	*25.1*	4.8	6.0
- stage VII.....	—	2.2	4.2	6.5	*17.0*	13.2	*15.5*	*29.9*	4.5	7.0

Vert. S.

Date. Maturity Stages	55	56	57	58	Total	Mean
15. Aug. III IV V.....	4	47	63	5	119	56.58
15. Sept. III IV V.....	1	35	60	4	100	56.67
—15. Oct. VII.....	7	237	144	5	393	56.37

It will be noted that the spent fish caught on the Fladen Ground between 15. September and 15. October, had an age composition similar to the fish caught at maturity stages

VI and VII on the coastal drift-net grounds in August.

The vertebral counts suggest that the herring between maturity stages III and V were of mixed types with autumn spawners predominating.

Small herring were observed amongst some of the trawl catches landed from the Fladen. A sample of these small fish collected from the catches produced the following results:

Size Distribution.

19	20	21	22	23 cm.	No. of Fish.
1.2	14.1	55.2	28.2	1.2 %	163

Vert. S.

56	57	58	Total	Mean
35	108	14	157	56.87

These herring had only 1 winter ring on the scales. The sample is not likely to be a representative one as many of the smaller fish had undoubtedly escaped through the trawl meshes. The sample is none the less interesting in that the vertebral counts indicate that this group of small herrings consisted predominantly of a spring spawning type.

Firth of Forth.

During the winter 1949—50 a good catch of 2-year-old herring was obtained within the area extending from Inchkeith to the Forth Bridge. There was, unfortunately, little evidence of a recovery in the stock of adult spring spawners.

Firth of Clyde.

The Clyde fishery was much less successful in 1950 than in the previous year. In both years the catch was maintained to a very large extent by brood produced during the spring of 1947. A large proportion of this brood spawned during February and March 1950 and left the estuary. The 1948 brood was very poor so that the 1950 fishery had to depend on the remnants of the 1947 brood which had yet to mature and spawn for the first time.

Tagging Experiments.

Experiments were made with the following 4 types of tag: (1) plastic band attached between the dorsal and pectoral fins; (2) plastic strip attached by a wire bridle in front of the dorsal fin; (3) hydrostatic tag attached as in type 2, and (4) rubber band applied between the dorsal and pectoral fins. The hydrostatic tag gave the best results. Table 6 gives a summary of results from taggings on the drift-net grounds during 1950.

Table 6.

Area.	Fish tagged	Fish recovered	Place of recapture	Days free
Shetland	1050	4	Fladen	42—62
Wick/Orkney ..	230	1	Fladen	75
Moray Firth ..	550	1	70′ E.S.E. of Peterhead...	87
Off Fraserburgh	1660	7	(2) Off Fraserburgh	1—2
- -			(3) Fladen	5—34
- -			(1) Off North Shields	105
- -			(1) North Dogger..	102
Off Peterhead..	915	5	(1) Off Peterhead .	4
- - ..			(1) Fladen	80
			(2) North Dogger..	68—100
			(1) Skagerak	257

In addition to the above, 3,100 herring were tagged on commercial trawlers fishing on the Fladen Ground. 8 fish were recovered on the same ground but in no case did the interval between time of tagging and recovery exceed a week.

HENRY WOOD.

The Dutch Herring Fisheries in 1950.

Drift-Net Fisheries.

The Dutch herring drift-net fishery started at the end of May. Data were collected from a great number of vessels covering about 60 % of the fishing activity of the whole lugger fleet. The number of nets used per ship was mostly 100. The nets were set either for surface or for deeper water fishing.

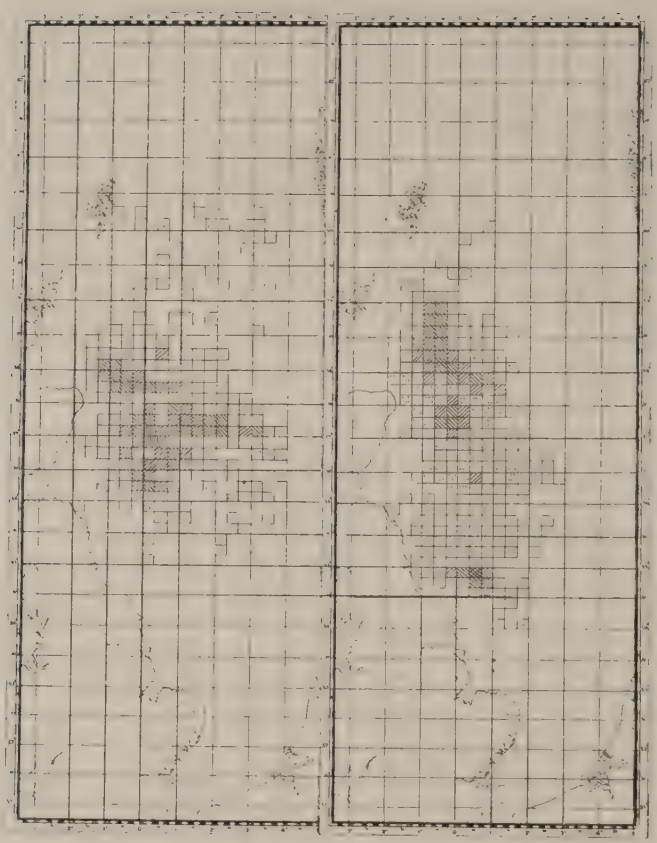
The Charts 1—21 have been composed in the same way as in previous years. The distribution of the fleet shows some differences from that in 1949, especially during June and July. The catches remained at about the same level, except in July and in October and November when the East Anglian autumn fishery started earlier than in 1949, with heavy catches.

Table 7 A gives the total quantity of drift-net herring landed. This quantity was below that of 1949, except in July and November.

J. DE VEEN.

Trawl Fisheries.

The Charts 22—26 give the catch of herring per 100 hours fishing of the Dutch steam trawlers fishing with the herring trawl. They

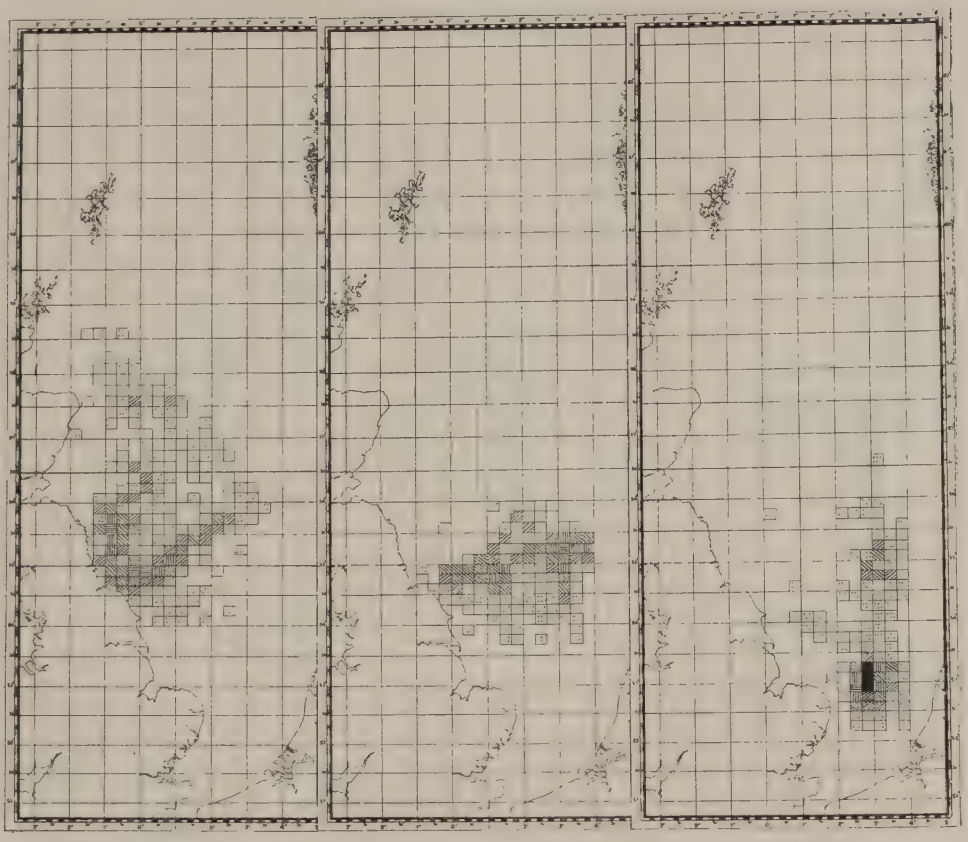


Charts 1—2. June. July.

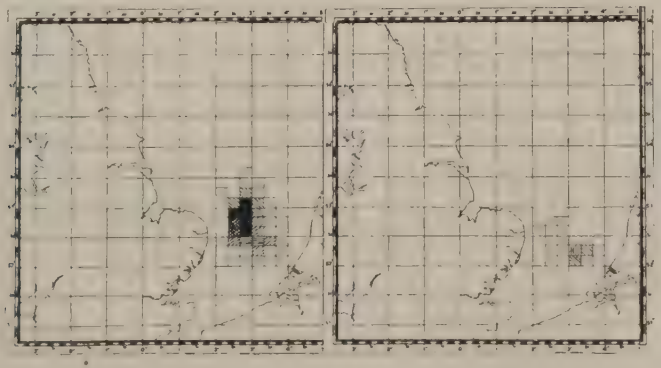
Table 7. Quantities of Herring landed in Dutch Ports.

Month	A. Landed in 1950 by the Luggers fishing with Drifts-Nets. Salted herring (in kantjes of 94 kg.) Matjes	Gutted Full	Spent	Ungutted	Fresh herring (in kg.)	B. Trawled Herring (in tons) landed in 1949 and in 1950. Trawlers 1949	1950	All kinds of vessels 1949	1950
January	—	—	—	450	76,965	73	1	2,153	141
February	—	—	—	—	—	515	130	1,456	145
March	—	—	—	—	—	217	291	218	303
April	—	—	—	—	—	92	50	93	52
May	—	—	—	—	—	36	20	37	32
June	27,535	—	—	402	—	9	132	9	142
July	71,794	524	—	2,866	—	1,992	1,043	2,397	1,689
August	22,083	12,933	36	2,421	3,120	4,885	4,905	8,571	10,366
September	9,873	45,178	4,809	27,154	22,700	4,562	5,677	8,927	10,673
October	41	31,059	3,295	280,634	4,940,716	3,670	2,935	5,055	3,550
November	—	4,531	354	165,550	6,211,668	721	106	721	109
December	—	1,066	46	18,861	2,022,639	58	40	177	289
Total	131,326	95,291	8,540	498,338	13,277,808	16,830	15,330	29,814	27,491

Number of Shots.



Charts 3—5. August. September. October.



Charts 6—7 November. December.

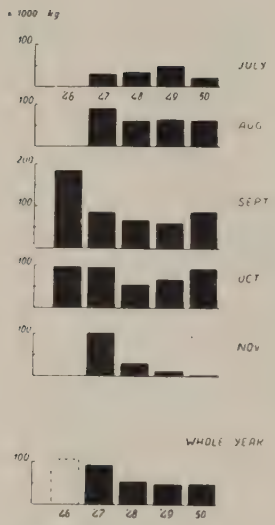
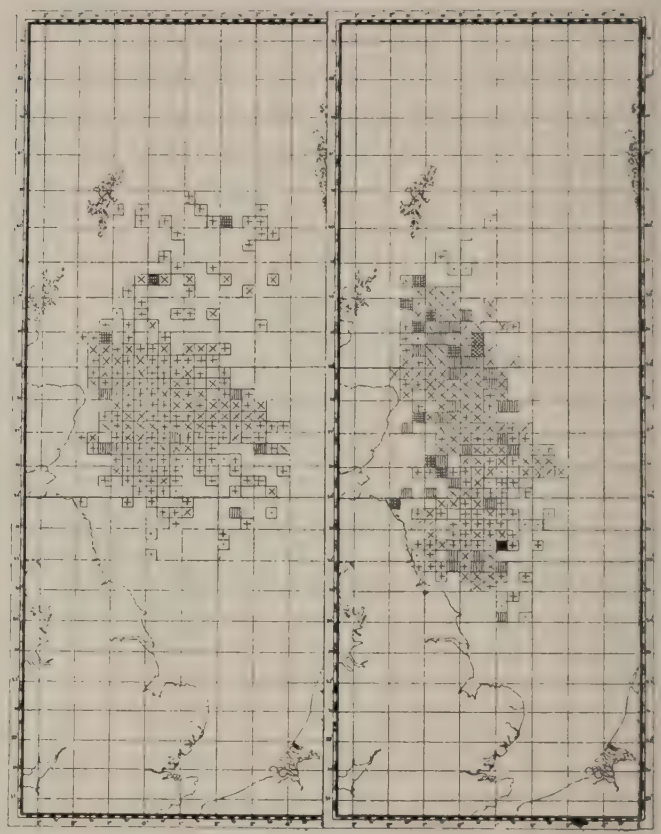


Figure 6. Mean Catch of Herring per 100 hrs. fishing by Dutch Steam Trawlers.

Mean Catch per Shot (in kantjes).



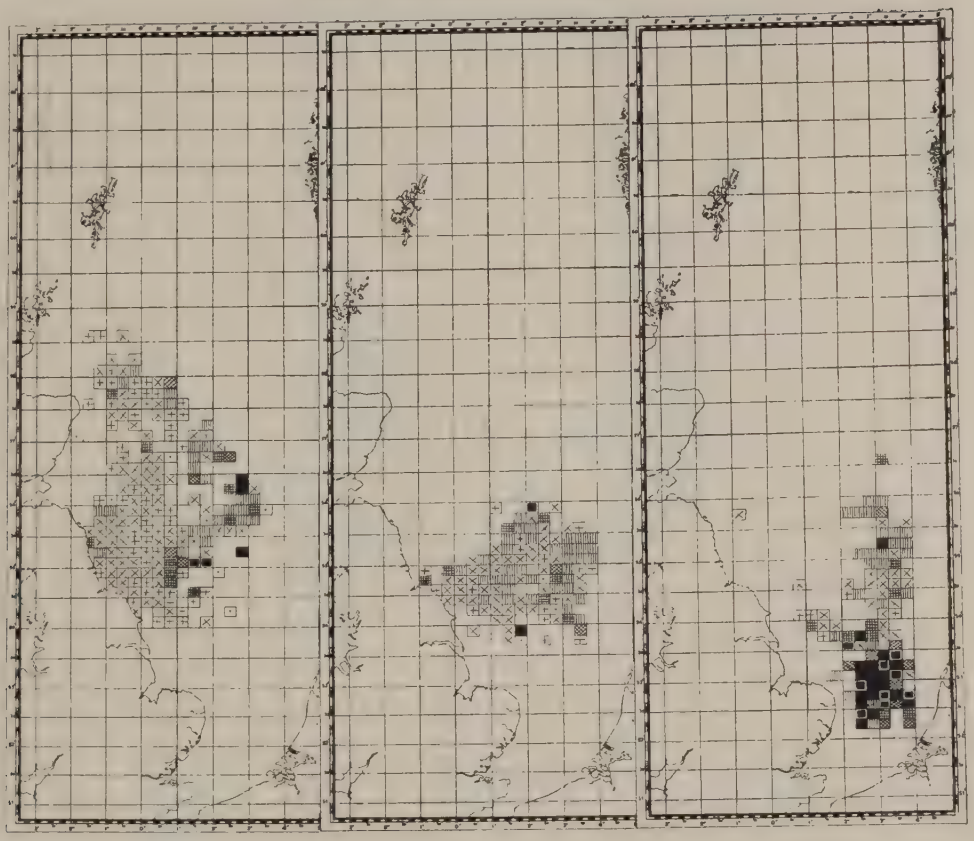
Charts 8—9. June. July.

show that in the northern area the catches were somewhat smaller and in the southern area bigger than in 1949. In the middle area they were about the same as in the previous year. This is also reflected in the mean catch per 100 hours fishing for each month of the successive years (Fig. 6).

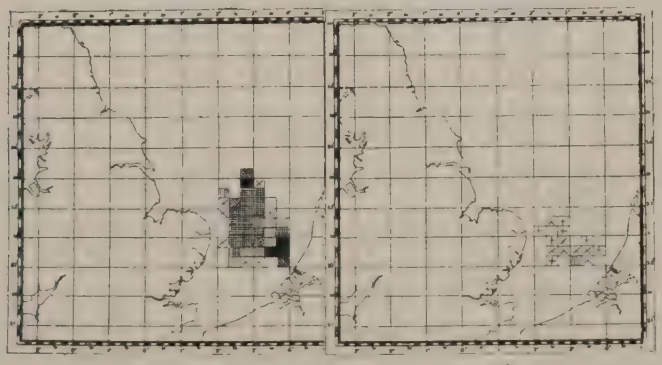
Table 7 B gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl nets. The total quantity landed is below that of 1949, due to decreased landings in most months except August and September. (The Table 1 A of the previous paper on this subject (Ann. Biol. VI, 1949) gives figures for only the trawled herring which were landed fresh and not for those salted. In order to correct this error the total figures of 1949 are given here again).

L. K. Boerema.

Mean Catch per Shot (in kantjes).



Charts 10—12. August. September. October.

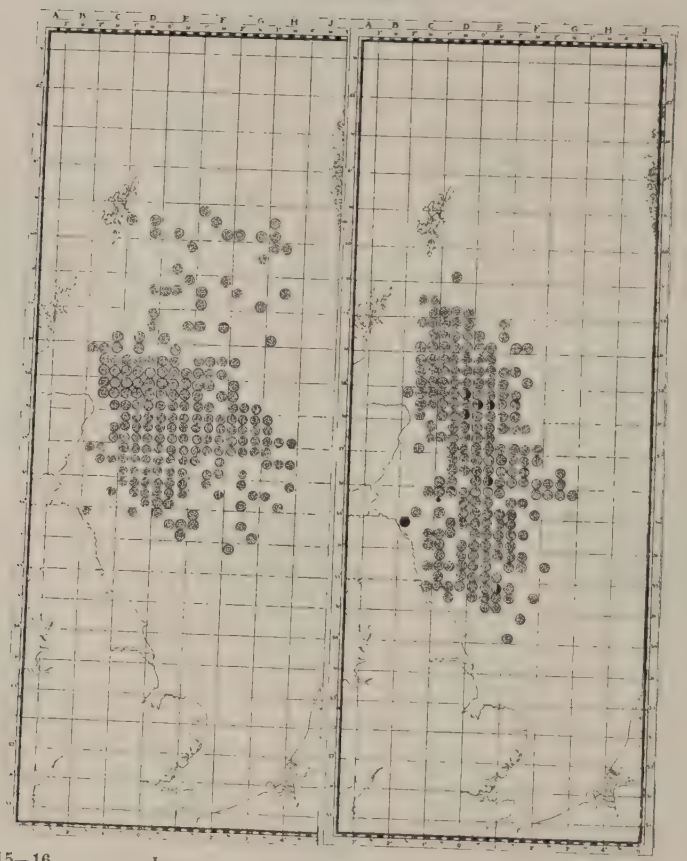


Mean Number of Kantjes per Shot

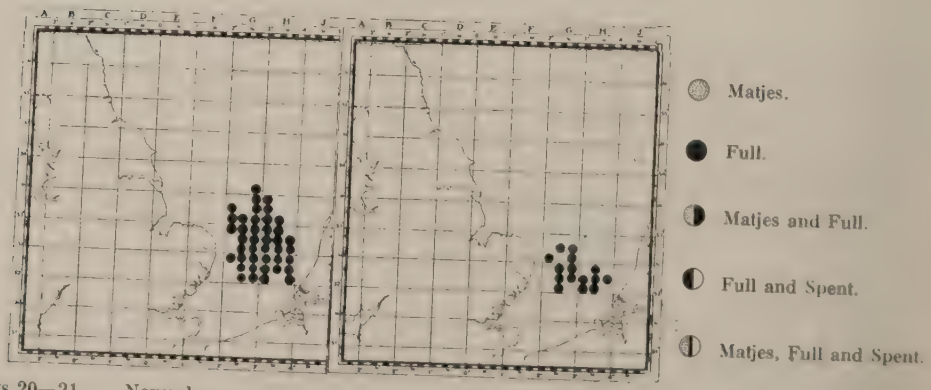
- 0
- 1— 9
- 10— 29
- 30— 49
- 50— 69
- 70— 89
- 90—119
- 120 and more

Charts 13—14. November. December.

Sorting.

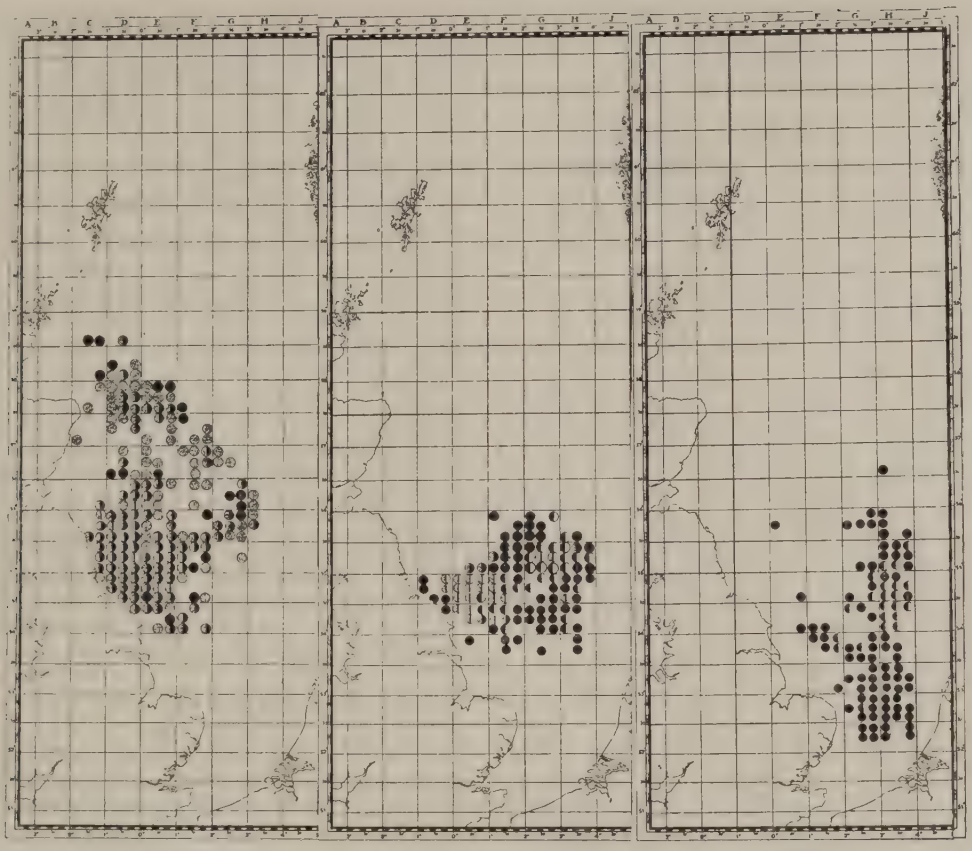


Charts 15—16. June. July.

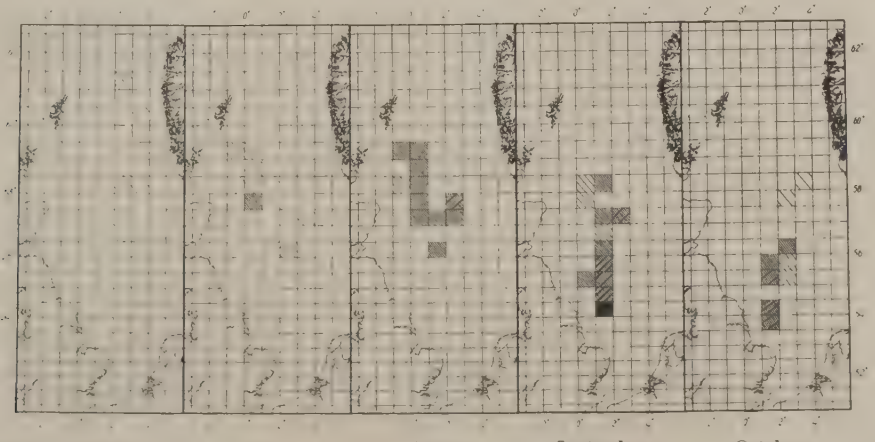


Charts 20—21. November. December.

Sorting.



Charts 17—19. August. September. October.



Charts 22—26. March. July. August. September. October.

5,000—10,000 kg. 10,000—25,000 kg. 25,000—50,000 kg. 50,000—75,000 kg. 75,000—100,000 kg. 100,000—150,000 kg. 150,000—200,000 kg.

The Belgian Trawl Fishery on the Full-Herring Concentrations.

A. Activity — Landings — Value.

The first full-herring catch was landed on 19. July 1950. It came from the Fladen ground where the herring fishery was carried on until the end of August. From early September until 15. October most trawlers were fishing south of this area, viz. the "Gut". As from the second fortnight of September until the end of October, the herring trawlers were mainly active around the western and south-western part of the Dogger bank. In November and December, full-herring concentrations were only exploited in the southern area of the North Sea, particularly around the light-ships "Ruytingen" and "Sandettié". There the fishery ended on 6. December 1950.

40 trawlers took part in the full-herring fishery. This total comprised 2 trawlers of Class II (motor trawlers of 80 to 119 H.P.), 9 of Class III (motor trawlers of 120 to 239 H.P.), 16 of Class IV (motor trawlers of 240 to 349 H.P.), 7 of Class V (motor trawlers of 350 to 500 H.P.) and 6 of Class VI (steam trawlers of 480 to 850 H.P.).

213 catches or voyages were recorded totalling 1,684 sea days or 15,997 effective fishing hours.

The H.P. developed is equal to the driving power of the trawler multiplied with the number of effective fishing hours. If, for instance, a trawler is driven by a 240 H.P. motor, it is considered as having developed 240 H.P. per hour.

During the 1950 season 7,555 tons of herring were landed. The catches in the various regions and in each month are shown in Table 9, and the average catch per vessel and per fishing hour and H.P. are shown in Table 10.

From the whole herring fleet 35 tons were landed per voyage, 4.5 tons per sea-day and 116 Kg. per fishing hour and per 100 H.P.

B. Biological Statistics.

The material studied comprises 1200 herrings. 280 were from the Fladen ground, 175 from the Gut and 745 from the south-western and western parts of the Dogger bank.

The material from the Fladen ground was collected in August; that from the Gut in August and September, and that from the south-western and western parts of the Dogger bank in September and October. (See Tables 13—16 A.)

The census for the vertebrae covered 1200 specimens of which there were 32, or 2.66 %, with one or more fused vertebrae and 4, or 0.33 %, with damaged vertebrae. These specimens have been eliminated from our material. (See Table 16 B).

Stomachal Contents.

Among the 1200 stomachs examined, 310, or 25.83 %, were found to have contents and of these 4 or 0.33 % were full, 12 or 1 % half full, and 293 or 24.38 % a quarter full.

The contents observed consisted mainly of copepods and smaller quantities of schizopods. One stomach contained a small mackerel of

Table 8. Number of the Belgian Herring Trawlers (t), and of their Voyages (v).

	Cl. II		Cl. III		Cl. IV		Cl. V		Cl. VI		Total	
H.P.	80— 119		120— 239		240— 349		350— 500		480— 850			
	t.	v.	t.	v.	t.	v.	t.	v.	t.	v.	t.	v.
(a) According to fishing grounds.												
FL.[1])	—	—	—	—	7	10	7	16	6	15	20	41
C.[2])	—	—	—	—	12	40	7	46	6	35	25	121
S.[3])	2	3	9	31	4	12	3	5	—	—	18	51
(b) According to monthly periods.												
July	—	—	—	—	—	—	2	2	1	4	3	6
Aug.	—	—	—	—	7	14	6	16	6	15	19	45
Sept.	—	—	—	—	13	26	7	23	6	17	26	66
Oct.	2	2	2	2	4	11	7	19	5	13	20	47
Nov.	1	1	9	26	4	11	4	7	1	1	19	46
Dec.	—	—	3	3	—	—	—	—	—	—	3	3

Table 9. Number of Sea-Days (S.D.) and of Effective Fishing Hours (F.H.).

	Classes of Vessels									
	II		III		IV		V		VI	
	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.
(a) According to fishing grounds.										
FL.[1])	—	—	—	—	115	1214	160	1650	159	1790
C.[2])	—	—	—	—	385	3989	383	3191	274	2205
S.[3])	12	66	123	1188	40	406	33	298	—	—
(b) According to monthly periods.										
July	—	—	—	—	—	—	21	279	43	593
Aug.	—	—	—	—	157	1702	160	1569	149	1620
Sept.	—	—	—	—	253	2843	185	1415	138	1029
Oct.	7	54	5	72	85	634	163	1444	90	663
Nov.	5	12	107	995	45	430	47	432	13	90
Dec.	—	—	11	121	—	—	—	—	—	—

[1]) Fladen Ground.
[2]) Central Area of the North Sea, chiefly the Gut and the western and south-western parts of the Dogger.
[3]) Southern Area, chiefly around the light vessels "Ruytingen" and "Sandettié".

Table 10. Total Weight landed (in 1000 Kg.).

	Cl. II	Cl. III	Cl. IV	Cl. V	Cl. VI	Total
(a). According to fishing grounds.						
Fladen ...	—	—	230	459	708	1397
C. Area...	—	—	1141	2159	2574	5875
S. Area...	3	153	70	56	—	282
% of total.	0.04	2.0	19.1	35.4	43.4	99.9
(b). According to monthly periods.						
July.....	—	—	—	49	138	187
August ...	—	—	358	590	959	1907
September	—	—	685	1314	1386	3385
October...	2.5	10	322	648	793	1775
November	0.8	131	77	74	7	289
December.	—	12	—	—	—	12

Table 11. Average Catch (1000 Kg.) per voyage (C/V) and per fishing hour for 100 H.P. developed (C/H).

	Cl. II		Cl. III		Cl. IV		Cl. V		Cl. VI		Total	
	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H
Fladen	—	—	—	—	23	66	29	68	47	61	34	64
C. Area	—	—	—	—	29	102	47	164	74	181	49	152
S. Area	1.1	47	5	72	6	63	11	47	—	—	6	63
July	—	—	—	—	—	—	25	44	35	29	31	32
August	—	—	—	—	26	71	37	91	64	91	42	88
September	—	—	—	—	26	86	57	224	82	217	51	167
October	1.3	43	5.0	75	29	180	34	109	61	207	38	151
November	0.8	69	5.0	73	7	64	11	43	7	15	6	56
December	—	—	4.2	59	—	—	—	—	—	—	4	59

about 7 cm. Some stomachs were found to contain eggs and scales of herrings and a few contained sand; this was most probably swallowed during the trawling or during the hauling of the nets.

C. Considerations about the Exploitation and on the Results.

I. Activity—Landings—Value.

In comparison with the full-herring season of 1949, there was, in 1950, a slight increase in the activity of the herring trawlers; 40 trawlers took part in the fishery as against 30 in 1949. The number of voyages increased from 172 to 213, the number of sea-days from 1,680 to 1,684 and the number of effective fishing hours from 15,545 to 15,997.

The total landings were 7,554,860 Kg. as against 8,794,195 Kg. in 1949. The average catch per sea-day was also lower at 4,486 Kg. as against 5,235 Kg., whilst the average catch per hour for 100 H.P. developed was somewhat higher at 116 Kg. as against 103 in 1949.

It seems peculiar that only the catch per hour's fishing for 100 H.P. developed had a higher average in 1950 than in 1949 while all other averages recorded in 1950 were lower. This was due to the average number of H.P. developed per fishing hour being considerably lower than in 1949, viz. 406 H.P. against 550 H.P. The density of the herring concentrations exploited by the Belgian herring trawlers tended to show an increase in 1950.

If we calculate the average catch per hour's fishing for 100 H.P. developed for each fishing ground separately we find that the density differs considerably from area to area.

It was in the central part of the North Sea (Gut and the western and south-western part of the Dogger bank) that the average catch per hour's fishing for 100 H.P. developed reached its highest level, viz. 152 Kg. against only 64 Kg. on the Fladen and 63 Kg. in the southern North Sea. The corresponding 1949 averages were: Fladen 96 Kg., western part of the central area of the North Sea, 124 Kg., southern North Sea, 59 Kg. Thus, from 1949 to 1950 the average catch for one hour's fishing for 100 H.P. developed decreased considerably on the Fladen ground but showed a substantial increase in the central North Sea and a slight increase in the southern North Sea area.

II. Biological Statistics.

In comparison with 1949, the average length of the herring in 1950 was 1 mm. lower at 161 mm. against 162 mm.

Table 12. Recapitulation of the Activity of the Herring Trawlers and of the Results recorded for the Period 1946—1950.

Season	Number of Trawlers	Number of Voyages	Number of Fishing Hours	H.P. devel. per hour	Weight landed (1000 Kg.)	Average Catch per Voyage (Kg.)	Average Catch Hour 100 H.P. developed	Value (1000 Frs.)	Average Price per Kg.
1946 ...	46	257	18,707	396	10,941	42,572	147	46,191	4.22
1947 ...	60	315	33,306	440	14,365	45,604	98	55,968	3.97
1948 ...	80	332	30,199	450	14,131	42,562	104	46,277	3.27
1949 ...	30	172	15,545	550	8,794	51,129	103	22,555	2.56
1950 ...	40	213	15,997	406	7,555	35,469	116	24,476	3.24

Table 13. Percentage Distribution.

A. Centimetre Class, Mean Length (cm.). Average Weight, and Sex.

	22	23	24	25	26	27	28	29	30	Mean	Aver. Weight	% Males
Fladenground	2.9	6.1	16.0	16.0	*20.4*	17.1	18.2	2.9	0.4	26.3	164 gr.	52.1
Gut	1.1	1.7	8.0	14.3	16.0	*20.6*	27.4	10.9	—	27.1	174 »	48.0
Doggerbank	2.8	13.1	*21.1*	20.5	14.8	13.6	12.2	1.8	0.1	25.7	148 »	50.3
Total	2.6	9.8	18.0	*18.6*	16.3	15.4	15.8	3.3	0.2	26.1	155 »	50.4

B. Stages of Maturity and Quantity of Mesenteric Fat.

	Stages of Maturity								Mesenteric Fat			
	I	II	III	IV	V	VI	VII	VIII-II	0	1	+	M
(a). According to origin												
Fladenground	1.4	1.8	*37.9*	34.6	23.9	—	0.4	—	0.7	28.9	32.2	*38.2*
Gut	—	1.7	12.6	18.9	*65.7*	—	—	1.1	22.3	*44.6*	21.1	12.0
Doggerbank	0.3	0.1	4.2	12.7	*36.5*	*36.5*	2.6	7.1	32.9	*39.1*	17.8	10.2
Total	0.5	0.7	13.2	18.8	*37.8*	22.7	1.7	4.6	23.8	*37.5*	21.7	17.0
(b). According to groups												
1st group (Stages I to III)	3.4	5.2	*91.4*	—	—	—	—	—	—	0.6	11.5	*87.9*
2nd group (Stages IV to VIII-II)	—	—	—	21.9	*44.3*	26.5	1.9	5.4	27.9	*43.7*	23.4	5.0

C. Year-Classes observed and Age-Groups of Total Catch compared for 1946-50.

Number of Herrings with readable scales in 1950 : 425.

Winter rings	2	3	4	5	6	7	8	9	+
Age (Years)	3	4	5	6	7	8	9	10	+
Year-Classes in 1950 catch	1947	1946	1945	1944	1943	1942	1941	1940	before 1940
Fladenground	15.5	*33.0*	8.2	6.2	8.2	14.4	7.2	5.2	2.1
Gut	2.0	13.3	11.2	10.2	13.3	13.3	*18.4*	10.2	8.1
Doggerbank	10.9	*31.7*	20.9	7.4	7.4	6.1	2.6	5.6	7.4

Table 14. Average Length (cm.) observed for each Year-Class.

Herrings born in	Age (Years)	North Sea Fladenground	Gut	Doggerbank	Total
1947	3	23.7	23.7	23.9	23.8
1946	4	24.7	25.1	24.9	24.8
1945	5	25.2	26.0	25.9	25.8
1944	6	26.1	26.8	26.8	26.6
1943	7	27.5	27.1	27.4	27.3
1942	8	27.7	28.1	27.9	27.9
1941	9	27.9	28.4	28.1	28.2
1940	10	27.9	28.3	28.4	28.3

Table 15. Average Value of L_1 (mm.) of each Year-Class.

North Sea	Year-Classes 1947	1946	1945	1944	1943	1942	1941	1940	Mean
Fladen	115	105	121	99	119	114	112	114	111
Gut	98	99	100	110	112	115	114	99	108
Dogger	112	107	109	112	116	97	117	105	110
Total	112	105	109	109	115	108	114	104	110

Table 16. Percentage Distribution.

A. Number of Vertebrae and Vertebral Average.

	Number of Vertebrae 55	56	57	58	59	Average
(a). According to origin						
Fladenground	3.6	45.1	*49.5*	1.8	—	56.49
Gut	3.5	*47.4*	46.2	2.9	—	56.48
Doggerbank	4.2	*46.1*	45.1	4.3	0.3	56.50
Total	4.0	*46.0*	46.3	3.5	0.2	56.50
(b). According to groups						
1st group (Stages I to III)	2.4	41.0	54.2	2.4	—	56.56
2nd group (Stages of maturity IV to VIII-II)	4.2	*46.9*	45.0	3.7	0.2	56.49

B. Keeled Scales (K_2) and Average.

	Number of K_2 12	13	14	15	16	17	18	19	Average
(a). According to origin									
Fladenground	0.7	5.0	31.8	*43.9*	17.5	0.7	—	0.4	14.76
Gut	—	5.2	27.7	*50.9*	11.0	5.2	—	—	14.83
Doggerbank	—	4.9	29.9	*45.6*	16.3	2.2	0.8	0.3	*14.85*
Total	0.2	4.9	30.0	*46.0*	15.8	2.3	0.5	0.3	14.82
(b). According to groups									
1st group (Stages I to III)	—	6.5	23.7	*50.9*	17.7	1.2	—	—	*14.83*
2nd group (Stages of maturity IV to VIII-II)	0.2	4.7	31.1	*45.2*	15.4	2.5	0.6	0.3	14.82

On the whole the young year-classes (3 to 6 years) were very well represented; they comprised 61.3 % of the total as compared with 37.2 % in 1949. The year-class 1946 (4-year-old herrings) was by far the best represented with 27.8 %.

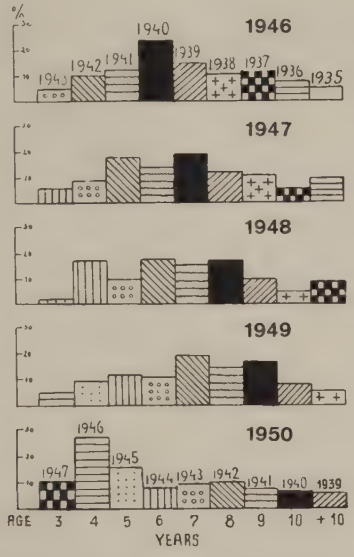


Figure 7. Biological Scale of the Full-Herring Concentrations exploited by the Belgian Herring Trawlers during the years 1946—1950.

The average value of L_1 for the different fishing areas showed little difference; it fluctuated between 108 and 110 mm.

In 1950, the average number of vertebrae was somewhat lower than in 1949—56.50 as against 56.53. This average differed slightly for the different fishing areas and varied between 56.48 and 56.50. This relatively low average number of vertebrae is brought about by the abnormally low average number of 56.56 for the herrings of the first group (herrings with stages of maturity I, II, and III) "spring-spawners" whose average is generally higher e.g. 56.73 in 1949.

In 1950 there was an increase in the number of "spring-spawners", they represented 14.4 % as against 5.1 % in 1949. As in previous years, this group was totally absent from the catches after October.

As the concentrations were composed largely of the younger year-classes (3 to 6 years), we may assume that the full-herring concentrations exploited by the Belgian herring trawlers underwent an appreciable rejuvenation and that they may turn up in dense concentrations during the next season.

Adverse weather and hydrological conditions as well as an unfavourable economic situation could make for a poor full-herring fishery but, if all these factors turn out to be favourable, we may expect next year's full-herring season to be a fairly good one.

Ch. Gilis.

La Pêche Française en Sud de la Mer du Nord et de la Manche orientale.

I. Lieux de pêche.

La campagne d'automne et d'hiver de pêche du hareng 1949/50 débuta vers le 10 Novembre dans les parages du Sandettié (chalutiers) et en même temps le long du littoral du Boulonnais (drifters). L'activité des chalutiers dans la région du Sandettié se poursuivit pendant un mois environ, jusqu'à la mi-Décembre, en donnant de bons résultats dans l'ensemble; la plupart des harengs capturés étaient au stade VI. La pêche artisanale des drifters le long du littoral du Boulonnais devait se prolonger sensiblement plus tard que de coutume (jusqu'à la fin de Janvier). Elle fut marquée par d'assez bonnes et régulières captures de harengs au stade VI. (Un certain nombre au stade VIII en fin de saison).

Le fait à la fois dominant et décevant de la campagne fut l'extrême médiocrité de la pêche du hareng «guai» (stade VIII) qui, durant les précédentes années — avec toutefois une activité décroissante pour les dernières campagnes — s'était localisée sur les bancs des Flandres, le long du littoral Belge et Hollandais, en Janvier et Février principalement. Quelques chalutiers de Boulogne ont opéré dans le secteur du Middelkerque Bank, au large de Nieuport, mais les résultats restèrent pour la plupart peu encourageants (Janvier). Les chalutiers se consacrèrent à la pêche du merlan qui se révéla fructueuse dans les parages du West-Hinder et du North-Hinder à partir de la fin de Décembre, jusqu'en Février. Quelques pêches très sporadiques de hareng guai se firent dans ces régions.

Les conditions hydrologiques au cours de l'automne et de l'hiver ont été caractérisées par une salinité élevée dans le secteur du

1. Chalutiers, 10. Nov.—10. Déc. St. V/VI. Bonne pêche.
2. Drifters. 15. Nov.—20. Janv. St. V/VI (St. VIII en fin de saison). Assez bonne pêche.
3. Chalutiers. Début Janv. St. VIII—II. Pêche médiocre.
4. Chalutiers. Merlans principalement et quelques pêches de harengs (fin Déc. à mi-Févr.).

Figure 8. Sud de la Mer du Nord et Manche orientale.
Principaux lieux de pêche du hareng, Novembre 1949—Février 1950.

Tableau 17.

Taille.

	Pourcentage et moyennes											
cm.	20	21	22	23	24	25	26	27	28	29	N	Taille moyenne
Mer du Nord												
Groupe Dyck-Sandettié[1])	1.6	11.6	13.9	12.4	12.7	12.1	15.9	12.7	5.7	0.3	343	24.28
Groupe North Hinder-Banc des Flandres	0.5	7.1	14.5	16.0	17.2	17.9	12.0	10.1	3.6	0.4	523	24.93
Manche orientale												
Groupe Nord-Somme	—	1.0	4.0	4.6	10.7	23.4	24.1	18.6	10.0	1.9	464	26.04

Age.

	Pourcentages											
Age	2	3	4	5	6	7	8	9	10	11	+	
Classe	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	Ant.	N
Mer du Nord												
Groupe Dyck-Sandettié[1])	0.3	37.2	24.0	10.0	5.8	10.0	5.8	2.0	2.9	0.9	0.3	341
Groupe North Hinder-Banc des Flandres	—	45.8	32.2	9.8	4.2	3.1	2.4	0.7	0.0	0.7	—	286
Manche orientale												
Groupe Nord-Somme	—	9.3	30.5	23.7	10.2	13.1	6.9	3.4	1.5	0.6	—	458

Taille moyenne et Age.

Classe	1946	1945	1944	1943	1942	1941
Mer du Nord						
Groupe Dyck-Sandettié[1])	221	245	258	266	—	—
Groupe North Hinder-Banc des Flandres	225	243	253	267	—	—
Manche orientale						
Groupe Nord-Somme	229	250	259	266	272	276

Moyenne vertébrale.

	Moyenne vertébrale. Pourcentage et moyennes										
Nombre de vertèbres	54	55	56	57	58	59	60	N	M	σ	Fl.
Mer du Nord											
Groupe Dyck-Sandettié[1])	0.2	2.1	40.4	52.2	4.2	—	0.3	331	56.58	0.66	0.101
Groupe North Hinder-Banc des Flandres	—	2.4	42.2	46.5	8.7	—	—	286	56.61	0.135	0.70
Manche orientale											
Groupe Nord-Somme	0.2	1.3	33.3	58.3	6.5	0.2	—	457	56.70	0.63	0.098

[1]) Sensu stricto.

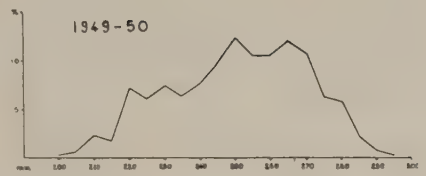


Figure 9. Harengs du sud de la Mer du Nord et de la Manche orientale. Courbe des tailles.

Sud de la Mer du Nord et de la Manche orientale (presque partout nettement supérieure à 35 $^{0}/_{00}$). Mais nous ignorons les causes hydrologiques ou biologiques que peuvent reconnaître, d'une part les bonnes captures d'automne sur le Sandettié et d'autre part la disparition du hareng guai le long du littoral belge.

Notre matériel d'étude provient de trois régions: 1° Sandettié — 2° Littoral du Boulonnais — 3° North-Hinder — Bancs des Flandres.

Précisons que le terme «Sandettié» s'applique à la région comprise entre les bancs Sandettié et Dyck. Nous sommes amené à faire une distinction entre les harengs provenant de cette région et ceux provenant des Bancs des Flandres. Sans aller en effet jusqu'à parler de deux populations distinctes, il faut cependant tenir compte de ce que les premiers sont pêchés en Novembre-Décembre, plus particulièrement, et sont en général au stade VI; les seconds sont pêchés plus tard, en Janvier-Février sont en général au stade VIII—II et peuvent ne pas constituer la «suite» homogène des premiers ainsi qu'en témoignent les observations sur les moyennes vertébrales. Dans nos précédents travaux la dénomination «Dyck-Sandettié» concernait plus spécialement le hareng au stade VIII—II pêché ces dernières années dans le secteur du littoral Belge — dont le banc Dyck fait partie à son extrémité NE. Cette année, pour la première fois, nous avons eu l'occasion de récolter du matériel provenant de pêches dans la région de Sandettié proprement dite. Il convient donc, pour plus de précision, de réserver à ce matériel le terme de «groupe Dyck-Sandettié» (au sens strict) et correspondant aux poissons étudiés sous ce nom à Boulogne, avant la guerre et d'adopter le terme de «groupe des Bancs des Flandres» pour les harengs «guais» qui font, en Janvier-Février principalement, l'objet de la pêche le long du littoral belge et parfois du littoral français jusqu'à Gris-Nez.

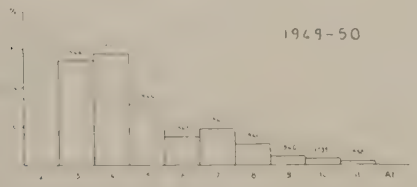


Figure 10. Composition du stock de harengs du sud de la Mer du Nord et de la Manche orientale.

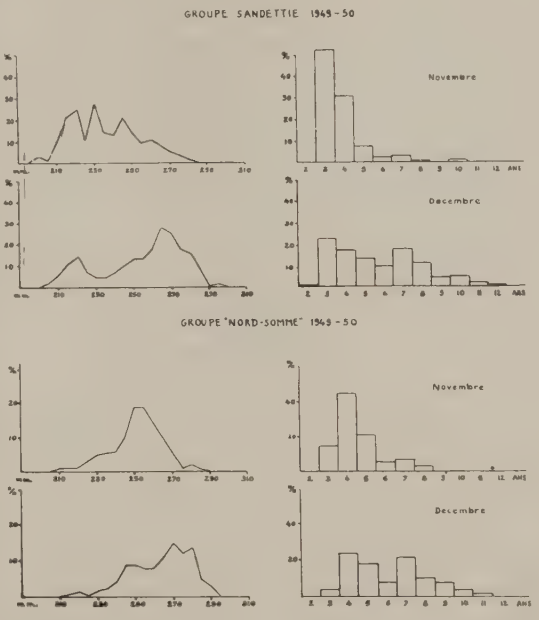


Figure 11.
Variation de la répartition des tailles.

Figure 12.
Variation de la composition du stock.

II. Composition du stock - Tailles.

Les diagrammes (fig. 10, 11 et 12), indiquent une nette prédominance des classes 1946 et 1945 (3 et 4 ans) et confirment le renouvellement du stock amorcé l'année dernière. La courbe de répartition des tailles (fig. 9, 11 et 12) et la composition des classes d'âge mettent en évidence le fait habituellement constaté de la prédominance des jeunes au début de la saison de ponte. Le mode pour l'ensemble des poissons mesurés (1.345) et les trois régions considérées est de 25 cm.

J. Ancellin.

The Belgian Spent-Herring Fishery along the Belgian and French Coasts in the Seasons 1948/49 and 1949/50.

A. Fishery.

I. Period, Fishing Grounds and Methods.

The first spent-herring catches were landed on 6. December 1949 and the last on 9. February 1950, so that the whole season lasted only two months whereas the previous season which began a fortnight earlier and ended a fortnight later lasted three months.

In the season 1949/50 the majority of the catches were taken in the coastal fringe of width about 10 sea miles stretching from Dunkirk to the Scheldt estuary. The smaller vessels were especially active inside or just outside the territorial waters, whilst the larger units mostly exploited the concentration outside the limit. In 1948 the fishery began near to the coast, especially in the "West-Deep", but in the later part of December the shoals were also found outside the territorial waters, mostly off Ostend.

The fishery was exploited exclusively by means of the trawl worked (a) by single vessels, and (b) by pairs of vessels using the "bull-net" which, in 1949/50, landed 40 % of the total catch. In the previous season the pair fishing method was used by a few vessels.

II. Activity of the Herring Fleet.

In comparison with the previous seasons there was a marked reduction in the activity of the herring trawlers. The number of vessels taking part in the fishery, which in 1948/49 was 258, was reduced to 176 in 1949/50.

The 176 vessels, which exploited the spent-herring fishery in 1949/50 were comprised as follows: —

Class	Number	Type	H.P.
I	109	shrimp boats	7 to 79
II	40	coastal trawlers	80 to 119
III	26	medium-sized trawlers	120 to 239
IV	1	small deep-sea trawlers	> 250

The reduced activity of the herring trawlers inevitably entailed a marked diminution of the number of voyages or catches, which was reduced from 3,776 in 1948/49 to 1,729 in 1949/50. (See Table 18.)

III. Landings and Value.

The spent-herring fishery which had, since the 1945/46 season, diminished in importance from season to season, reached such a low level during the season 1949/50 that it may reasonably be considered as having been a failure.

The total seasonal catch amounted to 2,426,337 Kg., or only 25.48 % of the total herring landings of the previous season (9,522,110 Kg.).

This enormous decline was due firstly to the small fishing effort of the herring fleet and especially of the Class III trawlers whose participation in the fishery was greatly hindered through the fact that vessels of more than 120 H.P. were allowed to fish inside territorial waters only at the end of the season and secondly to the poor density and early dispersal of the spent-herring shoals.

On account of the above-mentioned hindrance the Class III trawlers landed only 33.5 % of the 1949/50 seasonal catch whereas in 1948/49 and 1947/48 they contributed 59 % and 60 % respectively of the total landings. (See Table 19.)

The duration of a voyage or a fishing day rarely exceeds 24 hours. The average catch per voyage or fishing day for one H.P. developed, which was 26.4 Kg. in 1948/49, dropped to 16.7 Kg. during the 1949/50 season. This signifies a marked decline of the density of the herring shoals. (See Table 20.)

Comparing the average catch per day's fishing for one H.P. developed of 16.4 Kg. for the bull-net vessels with the 14.9 Kg. for single trawlers, the former method would seem to have been undoubtedly more advantageous and it may be expected that following this

Table 18.
Number of Voyages or Catches.

Month	Classes of Vessels I	II	III	IV	Total
Dec. ...	283	153	38	—	474
Jan.....	531	273	176	1	981
Feb. ...	181	60	33	—	274
Total...	995	486	247	1	1729
%.....	—	—	—	—	—

Table 19. Total Weight landed (in 1000 Kg.).

Classes of Vessels I	II	III	IV	Total	%
223	129	78	—	430	17.7
637	461	697	2	1797	74.1
116	46	37	—	199	8.2
976	636	812	2	2426	100.0
40.2	26.2	33.5	0.1	100	—

Table 20. Average Catch (Kg.) per fishing day/1 H.P.

Classes of Vessels I	II	III	IV	Total
13.7	9.3	13.0	—	11.9
19.6	18.7	22.7	8.4	20.4
11.6	8.8	6.3	—	9.4
16.6	14.5	19.1	8.4	16.7
—	—	—	—	—

Table 21. The Catch in the Seasons 1941/42—1949/50.

Season beginning	Weight Mill. Kg.	Value Mill. fr.	Catch (Kg.) per fishing-day/1 H.P.
1941.....	10.0	80.1	119
1942.....	51.9	352.5	164
1943.....	58.1	305.0	130
1944.....	31.4	167.0	160
1945.....	26.4	69.9	68
1946.....	22.2	40.8	50
1947.....	6.8	13.9	32
1948.....	9.5	17.2	26
1949.....	2.4	7.1	17

encouraging result the use of the method will in future become more widespread.

The enormous decline in the catch is seen from Table 21.

IV. Summary and a few Considerations.

It is considered that the scarcity of the spent-herring shoals can be attributed to the unfavourable hydrological conditions of our coastal waters during the spent-herring season. Some observations made during the past winter on our coasts showed the temperature to be excessively high which was probably caused by Atlantic currents penetrating through the Straits of Dover into the North Sea.

B. Biological Observations.

The results given in the statistical tables (22—25) are arranged according to the monthly periods. The aim of this arrangement is to ascertain when modifications in the composition of the herring concentrations probably occurred.

I. Summary and a few Considerations.

The average size of the herring in 1949/50 was 25.6 cm. as compared with 26.4 cm. in the 1948/49 season. This appreciable decrease of the average size is to be attributed to the presence of a big proportion of the two younger generations, namely the 3 and 4-year-old herrings.

The diminution of the average size of the individual inevitably involved a decrease of the average weight which was 100 g. as compared with 113 g. in the previous season.

Table 22. Percentage Distribution.

A. Centimetre Classes.

cm.	20	21	22	23	24	25	26	27	28	29	30	Mean cm.	Mean gr.	Males %
December.....	0.8	6.8	12.2	8.2	7.5	14.5	17.0	*20.5*	9.8	2.8	—	25.5	101	48.0
January.....	1.0	4.0	8.8	7.0	12.5	14.2	15.8	*25.5*	9.8	1.5	—	25.7	99	47.8
February.....	0.4	7.8	13.5	7.0	8.7	10.0	14.3	*25.2*	11.3	1.7	—	25.5	98	50.0
Total 1949.....	0.8	5.9	11.2	7.5	9.7	13.4	15.9	*23.5*	10.1	2.0	—	25.6	100	48.3
Total 1948.....	0.1	0.4	3.5	5.0	7.1	13.9	22.7	32.4	13.1	1.6	0.1	26.4	113	50.0

B. Stages of Maturity, and Mesenteric Fat.

	Maturity Stages								Mesenteric Fat.			
	I	II	III	IV	V	VI	VII	VIII-II	0	1	+	M
December.....	—	—	—	—	—	0.2	1.5	*98.2*	37.0	*62.8*	0.2	—
January.....	0.2	1.0	—	—	0.2	—	0.5	*98.0*	29.8	*68.8*	0.8	0.8
February.....	—	1.7	—	—	—	—	—	*98.3*	36.1	*62.2*	1.3	0.4
Total 1949/50.....	0.1	0.8	—	—	0.1	0.1	0.8	*98.1*	34.0	*65.0*	0.7	0.4
Total 1948/49.....	0.3	0.6	0.1	0.2	—	0.2	2.1	96.7	*49.9*	47.4	2.0	0.7

C. Year-Classes.

Winter rings	2	3	4	5	6	7	8	9	+	+	
Age (Years)	3	4	5	6	7	8	9	10	+	+	
Year-Classes in Season 1949/50	1946	1945	1944	1943	1942	1941	1940	1939	before 1939	before 1938	Number of readable Scales
December.....	17.8	*20.6*	8.7	6.3	8.7	7.9	6.3	7.9	15.8	—	253
January.....	12.5	*21.2*	6.2	4.4	16.2	13.8	6.9	5.0	13.8	—	160
February.....	*23.9*	16.9	7.0	2.5	13.9	6.0	8.5	7.5	13.9	—	201
Total 1949/50	18.4	*19.5*	7.5	4.6	12.4	8.8	7.2	7.0	14.7	—	614
1948/49.....	0.2	9.4	11.6	5.9	16.5	9.8	9.5	7.0	13.2	16.9	939

Table 23. Average Size (cm.) observed for each Year-Class and Growth during 1949.

Season	Year-Classes 1946	1945	1944	1943	1942	1941	1940	1939
1948/49	—	23.3	24.9	25.5	26.4	26.7	27.3	27.6
1949/50	22.3	24.6	25.4	26.6	26.8	27.2	27.7	27.7
Growth	—	1.3	0.5	1.1	0.4	0.5	0.4	0.1
L_1 1948/49	—	105	107	105	107	104	114	115
L_1 1949/50	110	107	104	106	105	112	110	110

The observed percentage frequency of the year-classes in 1949/50 showed a rejuvenation of the spent-herring concentration. The percentage of the 3 to 6-year-old herrings, which during the winter 1948/49 was 46 %, had risen to 50 %. Quantitatively, this increase may be considered to indicate the likelihood of the coming spent-herring fisheries showing favourable results.

The best represented year-classes were those of 1945, 1946 and 1942 which together constituted 50 % of the catch. Of the poor year-classes, the 1944 year-class contributed 7.5 %; in the previous season it contributed 11.6 %.

The average value of L_1 was about 1 mm. higher than that ascertained for the spent-herring concentration 1948/49.

As in 1948/49, the average vertebral count from December onwards was fairly high at 56.56, whereas, for the whole season, the average was only a little higher than that for 1948/49 viz., 56.61 against 56.57. From this we may infer that at an early stage the Channel herring joined the North Sea herring on our coast and that they were relatively more plentiful than usual.

The results show once again that the ratio between the values for the highest average number of cervical vertebrae and the total number of vertebrae is not fortuitous but is rather constant.

Of the 1030 stomachs examined only 3, or 0.3 %, had any contents which consisted mostly of remains of copepods.

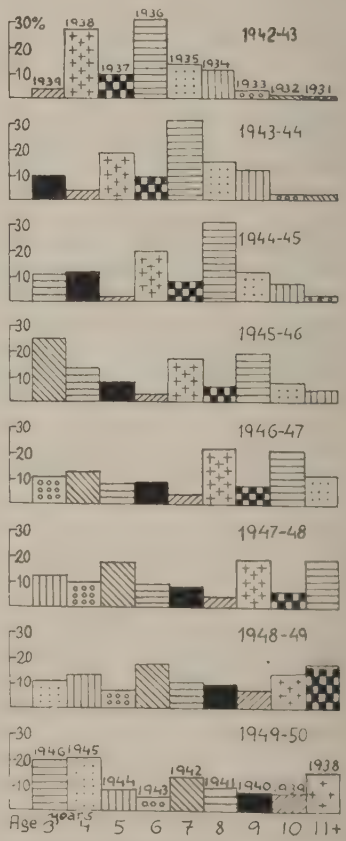


Figure 13. Biological Scale of the Spent-Herring Concentrations during the Winters 1942/43 to 1949/50.

Table 24. Percentage Distribution and Mean.

A. Total Number of Vertebrae.

	54	55	56	57	58	59	Means 1949/50	Means 1948/49
Dec. .	—	3.6	42.4	*48.3*	5.6	—	56.56	56.56
Jan...	0.3	1.8	38.0	*53.1*	6.8	—	*56.64*	56.58
Feb. ..	—	1.4	39.7	*53.9*	4.1	0.9	56.63	56.58
Total.	0.1	2.4	40.1	*51.4*	5.8	0.2	56.61	56.57

B. Keeled Scales (K_2).

	12	13	14	15	16	17	18	19	Means 1949/50	Means 1948/49
Dec. .	0.2	2.8	30.1	*50.8*	14.3	1.8	—	—	14.81	14.67
Jan...	—	3.5	28.1	*49.9*	16.5	2.0	—	—	14.85	14.78
Feb. ..	—	3.5	30.7	*45.6*	16.2	3.5	—	0.4	*14.87*	14.74
Total.	0.1	3.2	29.4	*49.3*	15.6	2.3	—	0.1	14.84	14.73

Among the 1030 spines observed, 35 (3.4 %) were fused; they have been omitted in our material.

Table 25. Cervical Vertebrae. Percentage and Mean.

Number of C.V.	22	23	24	25	26	27	28	Means 1949/50	Means 1948/49
Dec...	1.8	17.5	*49.9*	22.6	7.2	0.8	0.3	24.19	23.97
Jan...	1.8	25.5	*49.3*	17.6	4.5	1.3	—	24.01	24.06
Feb...	0.9	19.6	*45.8*	22.4	9.4	1.9	—	*24.25*	23.94
Total .	1.6	21.0	*48.8*	20.6	6.6	1.2	0.1	24.14	23.99

Total Number of Vertebrae.				
Total number of Vertebrae	55	56	57	58
of Spines...	24	398	510	57
Aver. No. of C.V.	23.86	23.94	24.23	24.70

C. Prospect for the Spent-Herring Fishery 1950/1951.

The large proportion of the two youngest generations viz. the 1945 year-class (4-year-old herrings) and the 1946 year-class (3-year-old herrings) present in the spent-herring concentration 1949/50 (totalling 38 %) undoubtedly signifies a marked rejuvenation of the concentration. It may thus be taken for granted that the spent-herring concentration 1950/51 will be characterized by a high percentage of 4 and 5-year-old herrings.

This rejuvenation must inevitably entail a decrease in the average size and weight of the herring whereas the density of the herring shoals must benefit from it.

Thus, if the hydrological conditions of our coastal waters do not hinder the grouping of the fish shoals, we may expect that the spent-herring will be more abundant than they were last season.

The result of the exploitation can evidently suffer through adverse weather conditions occurring during the season but, should weather conditions be favourable, we foresee a marked increase in the landings during the winter 1950/1951.

Ch. Gilis.

C. Skagerak and Northern Kattegat.

Danish Fisheries.

Young Herring for Processing.

Samples of young herring for processing caught, together with sprats, small whiting and other species, by trawl were investigated on 15. January and 19. March, and a sample caught by pound-net was examined on 15. April 1950. The lengths of these herring were 10—23 cm. Of the total about three-quarters were 0-ringed, a quarter 1-ringed and a few 2- and 3-ringed (winter ring 1949/50 not counted). The mean lengths of the 0-ringed fish in the three samples were 13.8, 14.1, and 13.5 cm.

Table 26. Racial Characters of 0- and 1-ringed Herring caught for Processing.

Rings	Length, cm.	V.S.	V.P.	K_2
0	10—13/14[1])	56.62 (126)	23.73	14.73 (211)
0	13/14—18[1])	56.43 (106)	23.80	14.49 (194)
1	15—22	56.49 (343)	23.74	14.85 (317)

[1]) In the sample taken 15. January the lengths were grouped as below or above 13.0 cm., but in the other samples as below or above 14.0 cm.

It is evident that the 1-ringed fish were pure autumn spawners from the western North Sea and that most of the small 0-ringed fish belonged to the same race group but were mixed to a small extent with winter or spring spawning herring with a high V.S. The larger 0-ringed fish were mixed North Sea autumn herring and coastal spring herring from the northern Kattegat or Bohuslän which have V.S. of about 56.2 and K_2 of about 14.2.

Herring for Consumption.

Trawled herring. A sample of herring caught by trawl on 11. August 1949 5 miles NW. of the Scaw consisted of fish of length 21—28 cm. (mostly 23—26 cm.). The age was not determined and only V.S. which was 55.95 (116 specimens) and V.P. which was 23.70, were counted. It is evident that the fish were coastal spring spawners from either the Limfjord, the Nissum Fjord, the Kattegat or the Belt Sea; from the knowledge so far obtained from tagging experiments it seems that they most probably originate from one or more of the three first-named areas. During the summer months full grown herring are rather scarce in these parts of the Skagerak and the northernmost Kattegat and they are

Table 27. Length- and Age-Distribution and Racial Characters of Herring.

A. caught by Trawl from Danish Cutters in the Skagerak during the Season 1949—50.

Length, cm., Percentages.

Maturity	15/16	17/18	19/20	21/22	23/24	25/26	27/28	29/30	31/32	Total
I-II-III...	0.1	2	9	11	6	5	3	0.2	—	36
IV-V.....	—	—	—	0.2	0.3	0.9	1.2	—	—	3
VII-VIII..	—	—	—	1	3	13	30	14	1	62
Total.....	0.1	2	9	12	9	19	34	14	1	101

Winter Rings. Percentages.

Maturity	1	2	3	4	5	6	7	8	9	10+
I-II-III....	13	14	4	2	1.4	0.5	—	—	—	—
IV-V.....	—	1.2	0.5	—	0.6	0.2	—	—	—	—
VII-VIII...	—	2	7	10	13	16	8	4	2	1
Total.....	13	17	11	12	15	17	8	4	2	1

Racial Characters. Numbers in brackets.

Maturity	V. S.	V. P.	K_2
I 1-ringed	56.61 (80)	23.89	14.74 (80)
I-II-III	56.65 (216)	23.97	14.72 (213)
IV-V.....	56.9 (18)	24.3	14.2 (18)
VII-VIII.....	56.45 (472)	23.76	14.82 (468)

B. caught by Pound-Net at Skagen 31. III.-3. IV. (S) and at Frederikshavn 4. IV. 1950 (F).

Length, cm. Percentages

Mat.		17/18	19/20	21/22	23/24	25/26	27/28	29/30	Total
I.....	S	1	2	2	1	—	—	—	6
	F	—	0.5	—	1	0.5	—	—	2
V.....	S	—	0.7	7	28	15	5	—	56
	F	—	—	9	47	20	4	0.5	81
VII-VIII	S	—	—	0.7	1	7	27	3	39
	F	—	—	—	3	9	4	1	17

Winter rings. Percentages

Mat.		1	2	3	4	5	6	7	8	9	10
I.....	S	2	3	—	—	—	—	—	—	—	—
	F	0.5	2	—	—	—	—	—	—	—	—
V.....	S	—	33	18	4	0.7	—	—	—	—	—
	F	—	44	26	11	—	—	—	—	—	—
VII-VIII	S	—	1	5	5	8	4	3	9	2	0.7
	F	—	3	6	4	3	0.5	2	—	—	—

Racial Characters. Numbers in brackets

Mat.		V.S.	V.P.	K_2
V.....	S	55.61 (83)	23.64	13.99 (83)
	F	55.82 (107)	23.64	14.14 (107)
VII-VIII.....	S	56.60 (58)	23.89	14.71 (58)
	F	56.13 (33)	23.47	14.22 (32)

taken only occasionally in the fishery for fish meal and trout pond food.

In the Skagerak trawl fishery during the season 1949—50 5 samples from both floating trawls and bottom trawls were investigated on 27. November 1949 and 4., 20., and 29. January 1950.

From the length and age-distributions and the racial characters shown in Table 27 A, it will be seen that the distribution according to maturity was about the same as in the 1949/50 season. The lengths of the herring of maturities VII—VIII was a little higher in the 1949/50 season than in the previous season and also, in these maturity-groups, the 6 and 7 year-old fish (5 and 6-ringed) predominated as compared with the 5 and 6-year-olds in the 1948/49 season.

The racial characters show that the spent herring were autumn spawners from the western North Sea. The young herring of maturities I, II and III consisted of a mixture of that same race with spring spawners of the Atlanto-Scandian type in about the same proportions as in the previous season.

The full herring, including a few with running milt or roe, seemed to be typical Atlanto-Scandian spring spawners.

Pound-net herring. Samples of herring caught in the pound-net fishery which begins when the trawled-herring season ends were examined at Skagen and at Frederikshavn. From results shown in Table 27 B it is seen that the majority were full herring, while spent herring constituted two-fifths of the Skagen samples and one-sixth of the Frederikshavn sample.

The spent herring at Skagen were North Sea autumn spawners whereas those caught at Frederikshavn must have been a mixture of this race and coastal spring spawners from the Danish waters, and perhaps also included some from the Swedish coast. The mature herring in both samples were typical coastal spring spawners from the Danish coasts. The tagging experiment (see below) shows that the coastal herring wandered to widely dispersed localities.

Aage J. C. Jensen.

D. Central and Southern Kattegat, Belt Sea and Baltic.

1. YOUNG STAGES

Danish Investigations.

Fishing with the ring-trawl carried on in February, March, April, May showed that, in April, winter-spawned herring, mostly of lengths about 14 mm. and spawned in December-January, were more abundant than usual. AAGE J. C. JENSEN.

2. COMMERCIAL FISH

Danish Fisheries.

Belt Sea.

The herring sold for processing (see Transition Area p. 109) were of lengths between 7 and 18 cm.; the average lengths varied between 11.0 and 14.7 cm., partly on account of various mesh sizes being used in the catching nets and partly because the small herring were mixtures of various races. In many cases the fish sold for processing were by-products from the sprat and herring fisheries after the larger herring had been sorted out from the catches. All of them were 0-ringed except about 14 % of those caught in Århus Bay on 7. December 1949 and 1 % of those caught on 13. December 1949. From the data in Table 28 it is evident that the 13. December sample was almost entirely of North Sea autumn spawners and that the 29. November sample had characters typical of the Kobbergrund herring while other samples were, no doubt, of mixtures including various proportions of this latter race. Coastal autumn spawners from the Danish Seas must contribute a considerable part to the mixtures as the V.P. is rather high. Of the twelve 1948/49 samples ten had a V.P. less than 24.10 as against six out of fifteen samples this year (comp. Table 1, p. 190 in Ann. Biol. VI). It will also be seen that the K_2 is, on the whole, higher this year than previously, while V.S. has a tendency towards lower values. The autumn spawning herring have been very scarce in the inner Danish waters during recent years, and the autumn fishing has therefore been very poor. Now it seems that the stock may be recovering.

Some samples, especially those taken on 12. January and 8. March 1950, have characters typical of the coastal winter spawners (see below).

Table 28. Mean-Lengths (cm.), and Racial Characters and Fat Contents (%) of Herring sold for Processing. Belts.

G: Great Belt off Kerteminde, Å: Århus bay,
N: North of Fyn, L: Southern Little Belt.
Numbers of Herring in brackets.

Date 1949	From	Length	V.S.	V.P.	K_2	Fat.
20.-10.	G	12.5	56.39 (96)	23.96	14.32 (84)	—
9.-11.	G	13.1	56.21 (234)	24.02	14.48 (194)	4.0
18.-11.	Å	14.0	56.01 (179)	24.20	14.42 (163)	5.0
29.-11.	G	13.8	56.32 (168)	24.23	14.54 (109)	4.2
7.-12.	Å	14.7	56.05 (175)	24.05	14.30 (164)	4.2
7.-12.	G	13.6	56.00 (43)	24.26	14.52 (49)	5.5
13.-12.	G	13.9	56.43 (129)	24.24	14.60 (135)	4.9
21.-12.	G	14.2	56.19 (120)	24.18	14.44 (120)	—
1950						
12.-1.	G	13.4	56.12 (129)	23.85	14.46 (126)	—
19.-1.	G	14.2	56.23 (115)	24.24	14.71 (115)	1.6
6.-3.	G	12.1	56.10 (109)	24.03	14.42 (170)	1.1
8.-3.	L	13.5	56.02 (157)	23.70	14.72 (195)	1.8
15.-3.	G	14.1	56.00 (58)	24.05	14.39 (53)	0.8
22.-3.	G	14.1	56.01 (137)	24.06	14.26 (116)	2.6
24.-3.	N	11.0	56.13 (86)	23.86	14.30 (77)	1.6

Southern Kattegat and Belt Sea.

The length distribution shown in Table 29 seems to indicate a rather homogeneous stock in each of the catches but in most samples there was a mixture of different maturity groups which, in some cases, represent different races.

From the table it appears that the full, spawning and spent herring from the winter months November—December had rather high V.S. and K_2 values as was also found in 1948 when these winter spawning coastal herring were investigated for the first time. They give rise to quite a large herring fishery during November—March in the southern Little Belt and are found also in other parts of the area. During March the racial characters of full and spawning herring in the samples become more typical of spring spawning herring, but the winter herring still seem to be present in considerable quantity. Thus, in sample No. 6 from April 1950 and sample No. 8 from September, the full (and spawning) herring had exactly the racial characters of these winter spawners. The immature young herring and the recovering spents were partly the same coastal winter spawners and partly spring spawners; autumn spawners were not found in any of these samples. From the number of winter rings it is seen that the herring in the

Table 29. Herring caught for Consumption in the Southern Kattegat and the Belts.

G = Great Belt, K: Kattegat Coast of Seeland, L: Southern Little Belt. P: Pound net, T: Trawl.

Maturities %

No.	Locality	Gear	Date	Stages I	II	III	IV	V	VI	VII	VIII	Total invest.
			1949									
1	Kerteminde (G)	P	11/11	34	20	13	9	9	1	12	1	181
2	Keistrup (L)	P	18/12	26	7	6	22	23	2	5	10	121
			1950									
3	Kalundborg (G)	T	4/3	4	4	—	3	66	1	10	13	103
4	Assens (L)	P	8/3	—	6	1	—	85	1	1	6	177
5	Aabenraa (L)	T	14/3	37	16	4	3	31	1	3	6	115
6	Samsø Belt (G)	T	13/4	—	3	—	—	87	2	6	1	80
7	Hundested (K)	P	24/5	1	26	—	—	16	7	38	12	119
8	Sjællands Odde (K)	P	27/9	7	17	11	9	54	1	—	1	110

Length, cm. (%).

No.	17/18	19/20	21/22	23/24	25/26	27/28	29/30
1	2	26	33	31	6	1	—
2	1	4	27	43	19	5	1
3	—	—	4	43	43	10	—
4	—	—	—	35	64	1	—
5	9	18	33	28	10	2	—
6	—	—	2	31	44	22	1
7	—	1	19	48	29	3	1
8	—	4	9	23	43	19	3

Number of Winter Rings in full and spawning herring.

(Ring 1949/50 not counted).

Ring	0	1	2	3	4	5	6	7	8	9
Year-class	49	48	47	46	45	44	43	42	41	40
1	—	5	62	17	15	2	—	—	—	—
2	—	8	40	31	9	8	1	—	1	1
3	—	1	41	50	1	1	1	1	1	—
4	—	1	27	70	2	—	—	—	—	—
5	—	14	59	22	3	—	—	3	—	—
6	—	3	54	23	10	5	4	1	—	—
7	—	5	37	51	4	2	1	1	—	—
8	11	32	27	16	8	3	1	1	—	—

Racial Characters

No.	Mat.	V. S.		V. P.	K_2	
1	I	56.10	(63)	23.80	14.66	(62)
	II–III	55.85	(62)	23.56	13.97	(62)
	V–VI–VII–VIII	56.08	(40)	23.90	14.42	(40)
2	I–II	55.97	(39)	23.82	14.28	(39)
	IV–V–VI–VII	56.24	(62)	23.89	14.43	(63)
	VIII–III	55.70	(19)	23.50	14.30	(19)
3	IV–V–VI	55.96	(72)	23.69	14.29	(72)
	VII–VIII	56.10	(22)	24.10	14.40	(22)
4	IV–V–VI	55.92	(95)	23.41	14.17	(93)
5	I	55.87	(47)	23.62	14.13	(46)
	IV–V–VI	55.92	(36)	23.69	13.92	(36)
6	V–VI	56.10	(71)	23.77	14.29	(70)
7	V–VI–VII	55.65	(106)	23.57	14.10	(106)
	VIII–II	55.74	(70)	23.56	14.05	(70)
8	II–III	55.67	(33)	23.58	14.07	(30)
	IV–V–VI	56.09	(75)	23.95	14.39	(75)

Table 30. Trawl-Herring caught S. E. of Bornholm, 1950.

Maturities. Percentages.

Date	I	II	III	IV	V	VI	VII	VIII
20/2	3	15	6	19	40	1	1	15
6/7	6	35	12	3	10	—	2	30

Lengths, cm. Percentages.

Date	cm. 17/18	19/20	21/22	23/24	25/26	27/28
20/2	2	13	31	36	15	3
6/7	1	12	38	39	10	1

Winter Rings. Percentages.

Ring 1949/50 not counted.

Date	0	1	2	3	4	5	6	7	8	9
20/2	1	24	37	12	9	11	6	1	—	1
6/7	2	15	10	18	33	12	7	2	1	—

Racial Characters. Numbers in brackets.

Date	Mat.	V. S.	V. P.	K_2
20/2	All mat.	55.51 (117)	23.75	13.97 (117)
6/7	II—III	55.36 (85)	23.91	13.62 (84)
»	IV-V	55.50 (24)	23.90	13.70 (24)
»	VII-VIII	55.65 (57)	24.12	13.73 (56)

first samples were mostly from the winters or springs of 1946 and 1947. In the September sample the younger year-classes 1947 and 1948 predominate.

The Sound. Herring for Consumption.

A pound-net catch from Køge bay was investigated on 31. October 1949. The percentage distribution of the various maturities were:

I	II	III	IV	V	VI	VII	VIII
28	24	36	7	5	1	—	1

It is clear that only a very few fish were spawning although, in the Sound, the herring fishery is normally almost exclusively an autumn fishery for spawning herring. Ever since the cold winters 1940—42 there have been only a few autumn spawning herring here as is also the case in the other inner Danish waters.

Omitting the herring of maturities V—VI, the percentage size-distribution was as follows:

17—18	19—20	21—22	22—23	24—25	26—27 cm.
1	21	22	50	6	0.4

There was no essential difference between the racial characters of the immature young herring and of those recovering, and for all except those of maturities V and VI they were: V.S., 55.70; V.P., 23.46; K_2, 14.02. These fish were evidently spring spawners, and tagging experiments proved that they had their spawning places at Rügen (see below).

Baltic.

Samples of trawl-caught herring from depths of about 70 m. E. of Nexø, taken on 20. February and 6. July 1950, were investigated (Table 30).

The length distribution was practically the same in the two samples and the maturities show that most of the herring were spring spawners with a small proportion of autumn spawners. The racial characters show that the herring in the February sample which were definitely spring spawners (Mat. IV, V, VI), very probably came from the southern coasts of the Baltic. The spents and recovering spents which formed the majority of the remainder must naturally have been autumn spawners; the number of these investigated is rather small but they accord best with the autumn herring of Bornholm. The immature herring may belong to the same race, but their number is too small to allow any conclusions to be drawn.

The same applies to those herring in the July sample which are definitely autumn spawners (Mat. IV, V). The spring spawners (the spents and recovering spents) of this sample had the same racial characters as the herring spawning at Rügen. The immature herring which the age distribution proves to be actually recovering, have a lower V.S. differing from that of the Rügen spring spawners by 0.29 while the $\sigma_{diff.}$ is 0.11. Consequently it is not impossible that they should belong to the same race, but they may well be spring spawners from the Swedish coast where herring with a low V.S. are known.

Aage J. C. Jensen.

Herring Tagging in the Inner Danish Waters.

From the Danish Biological Station 686 herring caught in pound-nets were tagged with the Lea-tag (see Table 31). Special attention was paid to technique and especially to the condition of the herring. It was found that undamaged, fully-scaled herring were recaught in considerably greater proportion than poorly scaled herring.

Table 31. Herring Tagging Experiments.

Place of tagging	Date	No. tagged	Recaptures Total 15. 5. 1951	Percentage 13. 12. 1950 of total	Percentage 15. 5. 1951 of fully scaled
At Kerteminde	25.-26.10. 1949	293	17	5.8	5.8	[1]
At Køge	31. 10. 1949	93	13	14.0	15.1	17.0
At Scaw-Frhavn	31.3.-5. 4. 1950	300	21	6.7	7.0	8.1

[1]) Degree of scaliness noted only for a few herring.

A detailed study of the recaught herring has not yet been carried out but a few general results may be mentioned.

In the first experiment, only a few autumn spawners were found in the catches from which the tagged herring were taken and most of those were spents (see the Kerteminde sample, Table 29). Most of the catches were of winter and spring spawners. It is well known that the autumn spawners come to the Belt Sea from the Kattegat just before spawning and that most of them go back to the Kattegat shortly after. It is interesting to note that 23 % only

were recaught to the north of the tagging place and 71 % to the south. 41 % were recaught in the western Baltic and southern Little Belt. Two herring, or 14 % of those which were recaught to the south, were taken near Rügen in February and April 1950. This makes it seem likely that there is a considerable wandering of spring herring between the Baltic and the Belt Sea, a feature which was totally unexpected.

One tagged fish was recaught by trawl in November 1950 to the north of the Dogger Bank (55° 45′ N. Lat., 2° 30′ E. Long.) in 82 m. depth. When tagged this herring was 242 mm. long and empty. We have not had the herring itself returned but no doubt it was one of the autumn spawners from the western North Sea of which we know that a large number will go to the Skagerak after spawning. It should be expected that some of these would stray from the Skagerak to the Belt Sea as most other fish species wandering to the Skagerak from the North Sea also do regularly or occasionally. That the young of this race wander to the Belt Sea has been proved by racial investigations but we have had no previous evidence that the spents also wander into the Belt Sea.

At Køge most of the herring tagged were spring spawners (comp. Table 30), and 12 of the recaptures were taken at Rügen during the following spring mostly when the large fishery for the spring spawning herring was in progress there.

During recent years Baltic spring spawners have constituted the main part of catches in the herring fishery in the Baltic and this tagging experiment showed that they do so also in the southern part of the Sound.

At the Scaw-Frederikshavn a mixture of mainly small and large coastal spring spawners and fewer autumn spawners was found (comp. Table 27 B). The recaptures came from Hanstholm (limit between Skagerak and North Sea), Nissum Fjord, Nissum Broad, Hvalpsund, the Kattegat coast of Jutland, the eastern Kattegat and Skagerak, the central Skagerak and one herring from the North Sea.

Aage J. C. Jensen.

Shellfish.

Statistical Investigations on the Shrimp *(Crangon vulgaris)*.

By

B. Havinga.

In this contribution a review will be given of statistical investigations on the shrimp that have commenced in 1951 and that will be continued in the following years.

The shrimp is by far the most important species of Crustacea in the Dutch fisheries. The large individuals are used for human consumption and the small ones are dried and used for poultry food.

Nothing is known about the influence of the fishing on the stock. It is certain that the natural mortality is very great, but in addition an intensive fishery is carried out and large quantities of immature individuals are caught. The question has often been raised whether the mortality caused by this intensive fishing has an important influence on the stock or whether this influence is negligible with regard to the great natural mortality.

This question is very important for the shrimp fishery because, if it could be proved that the recent method of fishing is harmful to the stock, it would be necessary for the benefit of the industry to look for protective measures; it is evident that there are possibilities in this respect as a large percentage of the catches consist of immature individuals.

An attempt will be made to try to find an answer to this question by examining the available statistical data, viz., the statistics of the landings during a long period and the catches per vessel per days absence since 1947. These latter data were kindly procured by the Marketing Board for Fishery Products, the Hague.

Total Landings.

In Table 1 the statistics of the landing sin the most important districts of the Netherlands are given for the period 1916—1950. In order to eliminate the annual fluctuations, averages are calculated for 5-year periods. The figures for small shrimps are included where available: since the statistics are incomplete, a blank in the table does not necessarily mean that no small shrimps were landed.

Considerable variations occur in the annual landings of large shrimps in the western part of the Wadden Sea. In the period 1931—1935 the landings fell to less than 50% of those in previous periods. This was caused by the enclosing of the Zuider Zee which was a very rich fishing ground for shrimps. In the following period, 1936—1939, the catches were extremely low due to lack of sufficient sale facilities. During the post-war years the landings have been fairly constant.

During the pre-war years, in the eastern part of the Wadden Sea, by far the greater part of the catches were used for drying as it was not possible to find a market for them for human consumption. In the post-war years the sale-facilities improved and a much greater part of the catches was sorted for human consumption, and more effort was spent on the catching of large shrimps.

In the estuaries of the great rivers, where there are no special reasons for variations, the catches have tended to decrease in the course of the years. At the end of the period 1916—1950 catches in the estuaries of the Scheldt were about 50% of those at the beginning of the period, and, in the estuaries of the Rhine and Meuse, about 60% of those at the beginning of the period.

It is impossible to make out if the decrease

in the landings has been caused by a diminution of the fishing intensity. In the beginning of the period the whole fishing fleet consisted of sailing vessels and now all the ships are provided with a motor. The number of vessels has declined, but the fishing capacity per vessel has increased owing to the introduction of motor power and larger-sized craft. On the other hand the larger and more powerful type of vessel is also used for catching fish in periods when this is more profitable. Due to these factors it is impossible to ascertain if the intensity of shrimp fishing has changed.

The decrease of the landings during the post-war years, however, cannot be explained by a decrease of the fishing intensity, and later on we shall see that the catches per unit of effort have also decreased during the period 1947—1950.

The decrease of the intensity of the fishery during the war did not give rise to an increase in the catches in the post-war years.

Catches per Unit of Effort.

It is a pity that we are unable to complete the landings during the whole period 1916—1950 with the catches per vessel per days' absence. I can only give these statistics for the years 1947—1950.

The figures were collected at 6 landing ports distributed along the whole coast of the Netherlands, in each of them 6 vessels, 3 relatively large ones and 3 small ones, were selected.

In Figure 1 the means of the catches per vessel per day's absence calculated for all 6 vessels are given for each landing port. As it would have cost too much time to collect the data for all the fishing days of the year only the catches in the first week of each month are dealt with.

In spite of the capriciousness of the curves it is clear that there are some regular features common to each year. This is still more obvious in Fig. 2 in which the means of the figures for the northern and for the southern districts are plotted.

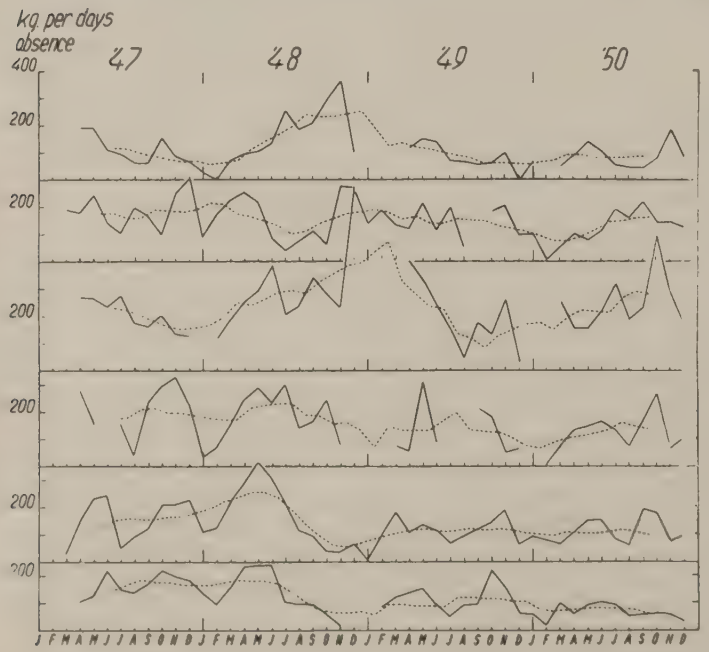


Figure 1. Catches of shrimps per vessel per day's absence. Means of 6 vessels from each of the ports of, (a) Zoutkamp, (eastern Wadden Sea), (b) Harlingen and (c) Texel (western Watten Sea), (d) IJmuiden (North Sea shore), (e) Stellendam (estuaries of the Rhine and Meuse), and (f) Arnemuiden (estuaries of the Scheldt).
Solid lines, daily catches in each month;
broken lines, moving averages calculated for 6 months.

Table 1. Catches of Shrimps for Human Consumption and for Drying.

Mean figures for 5-year periods and annual figures for the years since 1946 (1000 Kg.) The figures for the landings of small shrimp are incomplete.

Period	Estuaries of the Scheldt. For hum. cons.	Estuaries of the Scheldt. For drying	Estuaries of the Rhine and Meuse For hum. cons.	Estuaries of the Rhine and Meuse For drying
1916—20	2354	—	850	86
1921—29	2029	—	997	54
1926—30	2041	—	845	328
1931—35	2084	—	840	564
1936—39	1585	6315	913	1317
1946—50	1360	820	702	197
1946	1097	12	451	49
1947	1951	854	949	196
1948	1400	180	1045	104
1949	1163	1685	524	310
1950	1188	1367	542	327

	W. Wadden Sea (and Zuyder Sea) For hum. cons.	W. Wadden Sea (and Zuyder Sea) For drying	E. Wadden Sea For hum. cons.	E. Wadden Sea For drying
1916—20	3035	—	130	—
1921—29	2246	—	96	1019
1926—30	2550	—	115	2296
1931—35	1019	—	172	4576
1936—39	316	—	83	10164
1946—50	617	468	583	3483
1946	573	206	406	2029
1947	678	701	476	5306
1948	645	289	675	2765
1949	604	280	682	2602
1950	583	863	675	4712

In this figure it is quite obvious that there is a marked correspondence in the course of the curves and in the distribution of minima and maxima except, however, in the autumn of 1948. This discrepancy will be discussed later on.

The correspondence in the course of the curves in Fig. 2 is a proof that they are not too much affected by chance and that in both areas the shrimps are subject to the same conditions, save that in one single case a difference has evidently occurred.

One minimum in the landings occurs in winter (Fig. 1); often the fishery is not even carried out at all in January because of its not being profitable. Another minimum occurs in midsummer, either in July or, more commonly, in August. This minimum can be observed to occur with great regularity in every year in all the districts; it appears also very clearly in Figure 2.

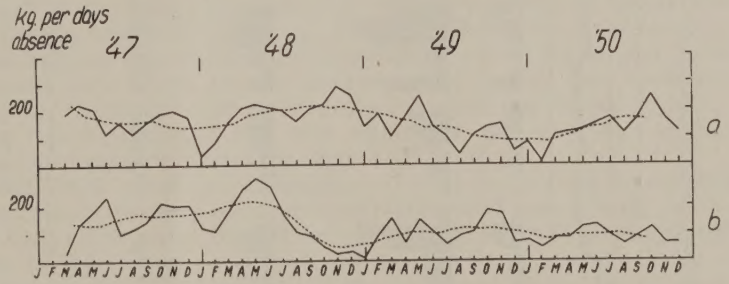


Figure 2. Means of the catches per vessel per day's absence in the northern districts (graphs a—d of Fig. 1) and in the southern districts (graphs e and f of Fig. 1). Solid lines, daily catches in each month; broken lines, moving averages, calculated for 6 months.

The cause of the winter minimum will most probably be the low temperature which induces the shrimps to migrate to deeper water. Presumably they are then dispersed over a wider area which makes the fishery less effective.

The minimum in July or August is more difficult to explain. The fact is known to the fishermen, but it has never before been observed by scientists. Which biological factors are responsible for this phenomenon is not yet quite clear, and it would take me too far to discuss this matter here.

The graphs provide a good picture of the density of the stock in the last 4 years, especially if we look at the moving average.

During the war and in 1945 the fishery was carried out with much restricted intensity; even in 1946 the fleet had not regained its former capacity. If the fishery has a material influence on the density of the stock one might expect large catches per unit of effort in 1947, and perhaps also in 1948. It is true that the catches in all districts were larger in these years than in 1949 and 1950, but the difference is so small that it can quite well be explained by the influence of natural fluctuations.

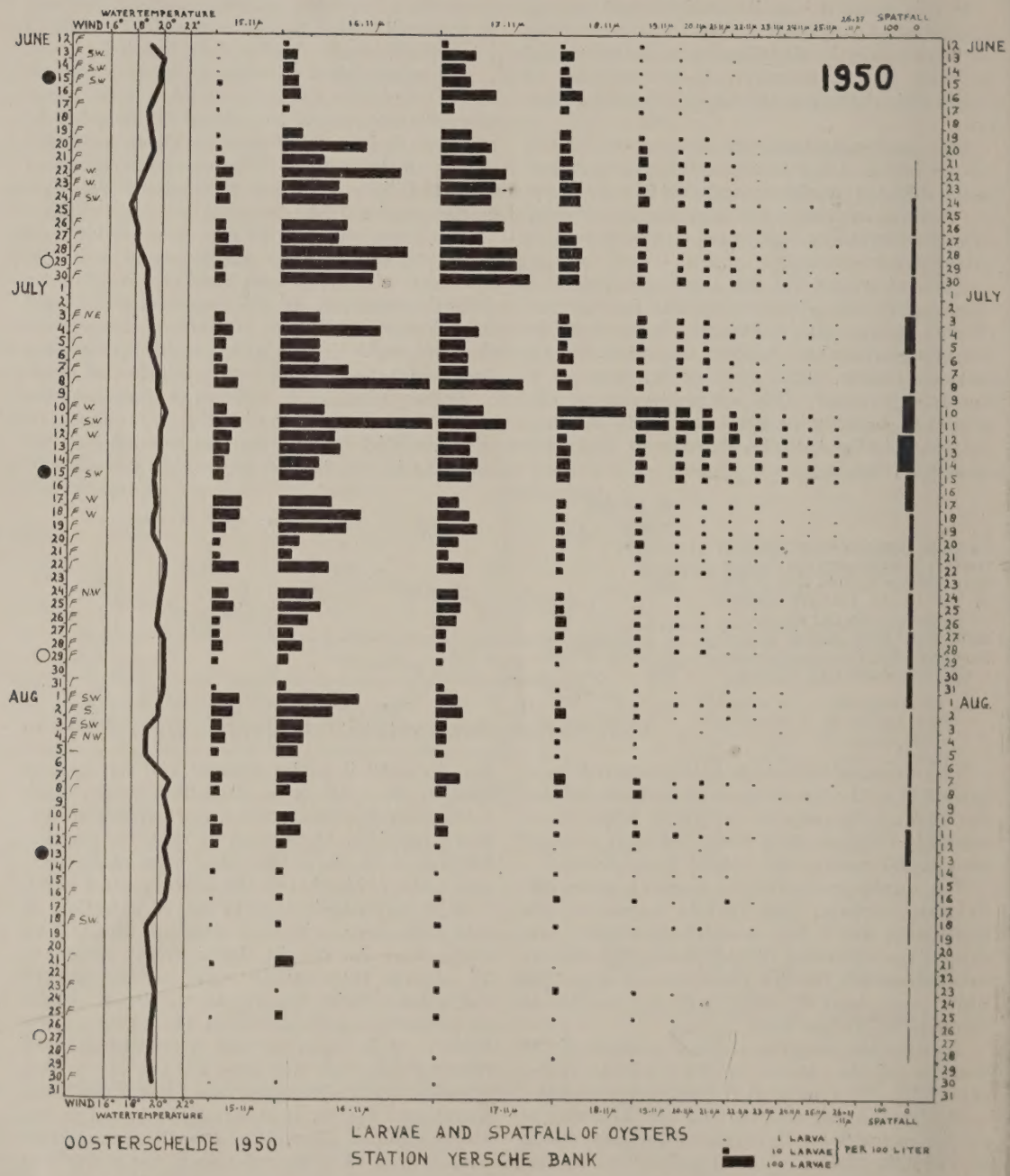
In the southern districts (Fig. 1, e and f) there is a sudden fall in the catches in the summer of 1948, which is a usual feature, but in this case it is not followed by the normal recovery in the autumn. The catches became so poor that in some ports the fishery was discontinued for a few months.

It is supposed that in the severe winter of 1946—47 the eggs or larvae were killed[1]). Shrimps with dead and decaying eggs were actually observed. If this explanation is right it is, however, difficult to understand why in the northern districts (Fig. 1, a, b, c), very large catches occurred in the autumn of 1948.

There is another difference between the northern and southern districts. In the southern districts (Fig. 2, b) the moving average in 1947 and in 1948 up to July is varying around 175 kg., in 1949 it varies around 100 kg. and in 1950 it does not even attain that value. Such a considerable fall is not observed in the northern districts. At the end of 1950 the moving average is at about the same level as in 1947 and only a little below the high level of 1948.

It is impossible to give an explanation of this difference with the data at hand. The cause may be sought either in the influence of natural fluctuations such as changes in natural mortality e.g. due to varying numbers of predatory animals or in the effect of the fishery. It is expected that a continuation of this investigation will give an answer to this question and to the other ones that have been mentioned above. It is especially the statistics of the catches per unit of effort over a longer period that will be of much value in this investigation.

[1]) Shrimps take about 2 years to attain a size at which they are fit for human consumption. (HAVINGA, B. "Der Granat (*Crangon vulgaris* Fabr.) in den holländischen Gewässern." Journ. du Cons., V, 1, 1930.)


WATERTEMPERATURE
WIND
SPATFALL
1950
JUNE
JULY
AUG.
OOSTERSCHELDE 1950
LARVAE AND SPATFALL OF OYSTERS
STATION YERSCHE BANK
1 LARVA
10 LARVAE
100 LARVAE
PER 100 LITER

Larvae and Spatfall of Oysters in the Oosterschelde (Holland) in the Year 1950.

By

P. KORRINGA

Bergen-op-Zoom, Holland.
Government Institute for Fishery Investigations.

FOLLOWING the usual observations on the number and size of oyster larvae in the water of the Oosterschelde (Holland), in our efforts to aid the local oyster industry by predicting the intensity of setting, plankton samples were collected and examined in the year 1950. The methods used in collecting samples of 100 litres of water and in counting and measuring the larvae in such samples have been described previously (KORRINGA[1])). The samples were collected at the station Yersche Bank in the centre of the Basin of the Oosterschelde. Daily samples were taken at high slack water from 12. June up to 24. June inclusive; twice-daily samples were taken, at high slack and low slack water, in the height of the season from 26. June up to 28. July inclusive. To follow the events in the remainder of the season which is, as a rule, of very limited practical importance, sampling once a day was carried through from 27. July up to 12. August inclusive, and every other day from 14. August up to 30. August inclusive. For technical reasons it was impossible to collect plankton samples on Sundays. Where two plankton samples were taken in a day, the average number of larvae in each size-class has been computed per 100 litres, and is depicted in the diagram. The intensity of setting was measured by exposing lime-coated glass slides at an angle of 45° in concrete containers for periods of 3 days, in the manner described by HAVINGA[2]) and KORRINGA[1]).

Our predictions, based on the number and size of the larvae, and on water temperatures, ran as follows:

In the general outlook (based on the size of the oyster population and on lunar periodicity, KORRINGA[3])), a fair production of larvae was predicted, which could lead in a not too cold season to a reasonably good set. A maximum in the production of larvae was predicted about 9. July, though it was considered probable that numerous larvae would appear already around 25. June.

Although by as early as 14. June the number of larvae was considered rather high for the time of the year, a set of commercial magnitude could not yet be announced. On 20. June an increase in the number of larvae was reported, and it was stated that the very first spatfall could be expected towards the end of that week, which spatfall could not yet be of commercial interest. On 24. June the number of larvae was given as fair, but the water temperature was unfavourable at that time so that no set of practical importance was expected. On 28. June the spatfall to be expected was still described as of moderate intensity. On 1. July a further increase in the number of larvae and a reasonable water temperature were said to co-operate in ameliorating spatfall prospects, so that the intensity of setting would improve towards the end of the next week. On 5. July the developments were described as satisfactory, though a really abundant set could not yet be announced. On 11. July the set was said to be fair or good at that moment and was said

[1]) KORRINGA, P. 1941. Experiments and observations on swarming, pegagic life and setting in the European flat oyster, *Ostrea edulis* L. Arch. Neerl. de Zool., Vol. V, pp. 1—249.

[2]) HAVINGA, B., 1939. Prediction of the time of setting of oyster spat and a method of control. Journ. du Cons., Vol. XIV, pp. 394—400.

[3]) KORRINGA, P., 1947. Relations between the moon and periodicity in the breeding of marine animals. Ecol. Monogr., Vol. XVII, pp. 347—381.

to be expected to remain of commercial interest for the next days, notwithstanding the rough weather. On 15. July a decrease in the intensity of setting was announced. On later occasions it was said that spatfall prospects were poor and no further set of practical importance was predicted.

The results obtained by the oystermen with shells and tile collectors were fair in the year 1950, locally even good. Practically all the collectors were placed early in July, so that all of those could benefit under the maximum in setting around 13. July.

It can be derived from the diagram that the measured intensity of setting agreed well with our predictions. The total production of larvae was fair with high figures around 9. July, and a more diffuse, but important maximum in swarming from 20. June up to 30. June, inclusive. The latter production did not lead to a spatfall of commercial magnitude, probably because of the rough weather and rather low water temperatures prevailing at that time. Roundabout 10. July larval development was considerably better and led to a set of commercial magnitude, which had its maximum intensity from 12. July up to 15. July inclusive. Considering the rather high water temperatures prevailing in the second and third decade of July, the percentage of the larvae reaching the setting stage and the resulting intensity of setting were somewhat disappointing, compared with other years. Maybe the weather, which was frequently very rough and rainy (though not affecting salinity perceptibly) had an unfavourable influence on larval development.

As the number of large and mature larvae observed correspond well with the measured intensity of setting (as usual) and as our spatfall predictions can be said to give a reliable outlook for the setting prospects, it is considered that our methods are satisfactory for this purpose. Although a greater frequency in sampling and a greater number of stations certainly could lead to a more detailed picture and to a greater statistical reliability of the data depicted, we confine ourselves for reasons of economy to the minimum frequency in sampling required for a reliable prediction of the intensity of the spatfall.